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ARCHEOLOGICAL INVESTIGATIONS AT ANTELOPE HOUSE

Don P. Morris
Senior Author & Project Director



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Antelope House under excavation. (Photo by Don P. Morris)

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Don P. Morris

Senior Author
& Project Director

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This volume is dedicated to Chauncey Neboyia,
companion, worker and friend.

Chapter 1

Introduction

Reported in this volume are excavations at Antelope House, Canyon de Chelly National Monument, Arizona. The project, under the direction of the senior author and financed by the National Park Service, spanned the field seasons of 1970 through 1973.

Our report proceeds from a general discussion of our excavation goals and other background material to a detailed discussion of the architecture of the site and the internal site chronology derived from this study. Sections of the report dealing with environment, diet and material culture present the results of detailed studies of the excavated materials. The concluding section of the report summarizes and integrates these studies, presenting conclusions on the social organization of the site and the state of the environment during its occupation, the two prime areas in which we concentrated our efforts.

Our goals throughout the project have been to understand better the ways in which the prehistoric population at the site dealt with its environment, the consequences of these actions for them and for the culture history of the area, and something of the nature of their social organization. A major field objective was stabilization, so that visitors to the area could visit the site and vividly comprehend the Anasazi achievement in this scenic canyon.

Like so many other sites in the monument, Antelope House is an imposing ruin, with thin, unstable walls, some of which towered as much as 8 m above the pre-excavation rubble. Although National Park Service crews partially stabilized the site in 1942 and 1956, it had deteriorated so much by the early 1960's that it was closed to visitors. In 1969, Charles B. Voll, then Monument Superintendent, developed a comprehensive plan for the ruin. It had two major objectives: (1) to stabilize the ruin, rendering it safe for visitors, and (2) to prepare a report on the excavated material, emphasizing the relationships between the people of Antelope House and their environment. The end result was to be the development of Antelope House as the principal interpretive point for the archeology of Canyon del Muerto.

Funds became available in July of 1970, due primarily to the vigorous efforts of General Superintendent John E. Cook. Work at Antelope House began in that month and continued seasonally through August of 1973. The time since then has been devoted to analysis of the abundant material recovered from the site. This report places in perspective the picture of environmental relationships at Antelope House which emerged from that analysis. During the long and intricate excavation of this site, which contained large quantities of perishable material, we attempted to do a complete and thorough job, as would most archeologists. The extent of our success may be measured by a review of our conclusions in the following pages.

Our interest in the prehistoric environment and in the ways raw materials were used at Antelope House required careful sorting of utilized from nonutilized plant remains. We attempted to collect all faunal material generally collected

in normal fieldwork, since these data should yield good ecological information. We incorporated in our excavation techniques comprehensive and thorough sampling and collecting of soil for pollen and flotation analyses. These procedures yielded the largest store of vegetal material known from a single site in the United States. By the end of the project, we had collected more than 900 pollen samples and more than 1000 flotation samples. It was obvious as we excavated that we would have neither the budget nor the need to analyze all of the material collected. For instance, of the 900+ pollen samples, only 143 have been analyzed. The unanalyzed samples are being held in storage in the hope that for some future researcher they may yield fruitful data.

Essentially, the same treatment has been given the recovered gross vegetal material. It is true, of course, that the manner in which this material was collected and stored may diminish its usefulness in terms of future, unknown research goals. On the other hand, archeological excavation is destruction, and we feel that one possible way to mitigate its effect is to collect many more samples than immediately necessary and to store them. It is certain that no one is going to be able to go back and collect pollen samples from the excavated areas at Antelope House.

Although this project represents the largest single excavation effort at the site, a great deal of unexcavated material remains at Antelope House for future work. Several Pueblo III rooms in the southern portion of the site were left unexcavated or were tested only slightly because their excavation would contribute nothing to the visitor's experience at Antelope House, and we already had an adequate sample of comparable material from nearby rooms. We know there is a very large Pueblo I site underlying the later pueblo known as Antelope House. This was tested only sporadically by us. We leave to archeologists of the future the monumental task of shoring up the Pueblo III walls of Antelope House in order to get at the Pueblo I and Basketmaker occupations beneath it. We have attempted to excavate the site, concentrating on the Pueblo III occupation, to answer questions of broad environmental significance, and at the same time to leave valuable data for future workers.

Setting

Canyon del Muerto, the major tributary of Canyon de Chelly, is the setting for Antelope House, a group of ruins about 6.4 km east of the junction of the two streams. At latitude 36 9′41″N and longitude 109 26′32″W, the site is in Zone 12SXR of the Universal Transverse Mercator grid, coordinates 063991 400238. The site is in Apache County, Arizona, at an elevation of 1752 m above MSL.

Canyon del Chelly and Canyon del Muerto have incised a network of steep-sided canyons in the gently sloping sandstone flanks of the Defiance Uplift, which here loses approximately 800 m of elevation in an airline distance of 10 km, traversing from east to west. In the vicinity of Antelope House, the narrow meandering canyon presents an abrupt U-shaped profile, as topographic relationships alter from horizontal to vertical and back to horizontal with startling rapidity. The canyon topography is the principal controlling factor in the distribution of water, plant resources and, as we shall see, the prehistoric human population in the region surrounding Antelope House.

Natural sources of water on the plateau are rare and intermittent. No springs are found and the only water of any consequence is located in potholes and catchment basins, which are full only during and shortly after rainstorms.

Water is much more abundant on the canyon bottom. The canyon contains a permanent free-flowing stream, Tsaile Brook, from the vicinity of Mummy Cave upwards into the headwaters of the drainage on Roof Butte. Throughout the remainder of the canyon, including the vicinity of Antelope House, the stream is intermittent, flowing steadily during the winter, gradually drying during the generally arid spring and early summer, and generally running again, often violently, in response to the thunderstorms of summer. Surface drainage may cease again in September, depending upon the amount of thunderstorm activity, but resumes in late fall when the canyon vegetation no longer transpires water.

In terms of human needs, a drink of water is never difficult to obtain at any time or place in the canyon bottom. A simple excavation in the sandy canyon alluvium will yield potable water at a depth of approximately 40 cm. During

the spring of 1973, following the most protracted and severe drought in modern records, the project staff was able to obtain all water necessary (approximately 50 gallons a day) from a shallow alluvial well, which reached water at a depth of 50 cm. Whether this happy situation would have continued in the face of several years protracted drought is unknown, but the alluvial reservoir seems more than adequate for the demands of the current canyon population.

Considerable variation, corresponding to the topographic and hydrologic contrasts discussed above, is observable in the plant communities as one travels through the canyon area. This diversity is discussed in detail in Part 111; at this point it is sufficient to observe that a variety of plants that would be widely separated in a more monotonous and uniform landscape is available in the immediate area, particularly within the confining rims of the canyon. From Antelope House, for example, it is little more than a 10-minute walk to the nearest Douglas fir, which is normally associated with higher, moister elevations, while pinyon, cotton-wood, willow, juniper and oak are readily at hand.

The site occupies a portion of the northwest side of a south-facing alcove and is situated just 2 to 3 m above the present level of the streambed. The site is built against the wall of an enormous rock shelter, the cliff above overhanging the site for a distance of more than 165 m. Although the angle of the overhang is quite gentle, its great height puts the site more than 30 m under the lip of the overhang. Thus it is both well sheltered from rain and receives bountiful sunlight, but remains cool during the hottest part of the day. The summer sun illuminates the entire site by about 8:30 a.m., but the site is again fully shaded by early afternoon.

After only a few days at Antelope House, we all felt the site was a delightful place to live and work. Since cliff dwelling sites are often portrayed as poor living sites and since the literature often claims that the canyon bottom is much colder than the plateau during the winter, we tried to measure temperatures at Antelope House and at a Navajo hogan on the plateau. We used a 7-day recording thermograph at each locality in standard instrument shelters. We attempted to acquire data for an entire year.

Although our experiment was plagued with logistical and mechanical problems, we concluded that Antelope House was generally warmer, with less extreme daily variations in temperature, than the plateau site. About 3° C could not be accounted for by the difference in elevation between the sites; this is apparently caused by the concentration of solar energy by the rock shelter walls and reradiation of absorbed heat at night by these walls. We noted that Antelope House was more protected from the prevailing southwest wind than are most sites.

These measurements and our work experience indicate that the Antelope House alcove was inhabited because it was an exceptionally favorable spot, both winter and summer. It was far superior to the solar ovens, euphemistically called house trailers, in the Park Service housing area.

Antelope House occupies about one quarter of the available space in its alcove. The site is restricted to a talus pile of large boulders and debris which fell during the formation of the overhang. The remaining level ground beneath the overhang appears to have been unoccupied in prehistoric times. An occasional sherd is found in this flat area, but no structures are in evidence, prompting the conclusion that the land probably was used for agriculture.

Less than 20 m from the northernmost masonry of the site a modern Navajo farmstead is under cultivation. A portion of this field is sheltered beneath the overhang, which explains the traces of Navajo irrigation ditches in the area. Additional fields are located on the canyon bottom directly across from Antelope House and in the numerous rincons in the vicinity. More arable land can be found today within 1 km of Antelope House than can be located in the downstream reaches of del Muerto, where the canyon is significantly narrower. Other fields are found in the widest part of the canyon, from Twin Trails to Mummy Cave.

CDM 57, a Pueblo I site, is situated on the flat canyon bottom 200 m east of Antelope House, indicating the presence of this ground surface during occupation of Antelope House. The canyon soils have been studied only superficially, but Navajo experience indicates that the soil is eminently suitable for maize agriculture.

The vegetation in the vicinity of Antelope House is typical of the group designated Canyon Bottom Communities by Dennis and Harlan, as defined in Part III. The site is now screened from the stream by a dense stand of cotton (*Populus*

wislizenii) and willow (*Salix amygdaloides*) planted in 1941 to protect Antelope House from further erosion. Photographs of the site prior to that date show virtually no shrub or tree-like vegetation in its immediate vicinity. Other species growing immediately at hand include jimson weed (*Datura meteloides*), prickly pear (*Opuntia phaeacantha*) and yucca (*Y. baccata*).

The modern fauna of Canyon de Chelly is described by Burgess (1972). Due to modern use and occupation of the canyon, animals are not a conspicuous or prominent part of the natural scene. The woodrat (*Neotoma* sp.) is perhaps the most common wild animal regularly seen near Antelope House.

Visitors to the Canyon de Chelly area frequently get the impression that populations living in the canyon were isolated, walled off from surrounding regions. Greater familiarity with the terrain reveals numerous trails near Antelope House, which allow access from the canyon bottom to the plateau on either side of the canyon. While the canyon is steep-walled and spectacular, it is only about 183 m (600 feet) deep. At Antelope House an individual in good condition can travel from the plateau to the canyon bottom or vice versa in about 10 minutes. Trails which allow this access are listed in Table 1.

Thus it is possible for an individual on foot to leave the canyon on either side at several points in the vicinity of Antelope House. The flat canyon bottoms provide an easy, well watered route for travel between the mountains and the Chinle Valley; the route which passes from Antelope House to Lukachukai Pass, for example, is the shortest route to Mesa Verde and the San Juan Basin.

The immediate environment of Antelope House provides abundant water, arable land, shelter, ready access to a diverse floral assemblage, and a warmer, more benign climate than does that of the general region. These characteristics can be duplicated at many other nearby canyon bottom locations, indicating that the canyon floor and rock shelter habitations offer several advantages, primarily easy access to critical resources, for those occupying the area.

Table 1. Trails giving access to Plateau.

	Distance from Antelope House	*Difficulty*
North Rim (downstream)		
Morris' Folly	.6 km	4
Baby Trail	1.3 km	3
North Rim (upstream)		
Standing Cow	2.1 km	3
South Rim (downstream)		
Antelope	.6 km	2
Bridge	1.6 km	2
South Rim (upstream)		
Many Ladders	2.0 km	4

The trails are classified as follows:

1. Graded and smooth route suitable for casual walking. An example is White House Trail.
2. Sheep or horse route; easy walking and easy to find. An example is Bat Trail.
3. Scrambling route for people only, with the use of toeholds and handholds in some places. Carrying a rope in the party is advisable. An example is Baby Trail.
4. Toe and handholds, with exposure. Rope should be carried routinely. An example is Many Ladders Trail.

Chapter 2

Excavation Goals and Techniques

The broad aims of the excavations at Antelope House were: (1) to stabilize and strengthen the standing walls so that visitors might safely enter the site, and (2) to provide a scientific report on the findings of the required excavations. The two major goals are related, in that complete stabilization requires knowledge of subsurface conditions and of hidden areas of structural instability within the site; hence the logic of total excavation or, at least, of total excavation of discrete units.

The excavation of Antelope House was initially seen as an advantage, since knowledge of the archeology of Canyon de Chelly was severely restricted in several aspects. Although one of the classic areas of the Southwest, due primarily to Earl Morris' discoveries in the 1920s, our knowledge of subsistence, community organization, settlement systems and the paleoenvironment was limited. Steen's (1966) is the sole published excavation report. The most comprehensive work on the archeology of the canyon, David L. de Harport's doctoral dissertation (1959), has languished virtually unread and uncited in the library at Harvard University. The Antelope House project attempted to correct some of these deficiencies and to provide additional insight, using new techniques and concepts of investigation. The project's research goals and methods can be grouped under the major headings mentioned as deficient above.

Paleoenvironment

The material for investigating the paleoenvironment is the wealth of superbly preserved vegetal refuse. Although problems exist in studying culturally biased refuse for straightforward environmental information, the study of this deposit in conjunction with studies of the modern vegetation comunities (Halse 1973) should produce a reliable model of the prehistoric environment. Of the major aspects of the study, largest in scope was the analysis of vegetal material—the kilograms of leaves, twigs, husks and stalks that abounded throughout Antelope House. We wished to understand the species and their relative abundance through time, as well as related questions of cultural import. What parts of which plants were used? By what techniques were materials processed into artifacts? What were the consequences of this use for both the human and the plant populations in the region? What was the effect on other animal populations? Were there changes through time in the abundance of particular species? If so, were these caused by "natural" or "cultural" processes?

Initially we envisioned a situation in which a growing population utilized the local plant communities more and more through time. Around AD 1275–1300, this exploitation, plus changing climatic factors, resulted in virtual abandonment of the canyon. Recovery of the

vegetation followed, only to be met at about AD 1750 by the arrival of the Navajo, whose herds have further altered the plant communities. The present scene, therefore, does not truly represent the environment in which the Anasazi functioned.

Diet

Dietary studies were based on the abundant and well-preserved coprolites from the site, which constitute one of the largest collections available for study anywhere. Our aim here was simply to understand the nature of the diet, its changes through time and its adequacy. Which components of the diet were derived from cultivation and which from a collection of wild materials? How significant were the so-called "encouraged," or semi-cultivated, species? Could we substantiate the year-round occupation of Antelope House or was there an element of seasonality, as hypothesized by de Harport (1959)?

Pollen analysis of the archeological deposit was undertaken to supplement the studies mentioned above and to allow comparison of our results with those from exposed sites, where only pollen was available for study. We intended to investigate the degree to which the pollen sample from a given provenience was representative of the vegetal material it contained. Could the pollen sample yield more reliable information about subsistence activities in a particular room than the refuse dumped into the room after abandonment?

Since earlier studies already have demonstrated the importance of agriculture to the Canyon de Chelly area (Anderson and Blanchard 1942), we were interested in detailed study of the maize, as well as of the cucurbits and beans in the site. Were there changes in varieties through time? How important in the diet was each species? How and where were these crops stored and processed within Antelope House? Was cotton grown at Antelope House?

The aims of the faunal analysis were identical to those of the vegetal analysis: to develop a basis for understanding the paleoenvironment, the animals exploited and the uses to which they were put. Today the area is inhabited by Navajo, who keep the deer and larger animal populations at a minimum, especially within the canyon, whose sheer walls and dead-end rincons made it a natural animal trap (Burgess 1972). If this situation held for the Anasazi, we hypothesized that the larger animals would be less significant in later periods because an expanding population would have reduced numbers of such animals and then turned to smaller creatures for subsistence.

The role of the turkey in subsistence interested us. What did the turkeys eat? Did they scavenge trash or were foods potentially edible by humans diverted for their consumption? Was there a change during periods of stress? What birds were hunted? Was the use of feathers in ceremonialism at Antelope House similar to that of the modern Zunis and Hopis?

Site Abandonment

The studies mentioned above were also directed to the question of site abandonment and the "Great Drought" hypothesis for abandonment of Canyon de Chelly. If this hypothesis is correct, we should detect obvious and substantial changes in the cultivars, gross vegetal remains, pollen and feces as climatic disaster upset what is commonly depicted as a serene and well–adjusted way of life. In particular, we carefully examined the maize at our disposal for drought effects, in the form of stunted ears with imperfect row development which would have been used more frequently as the crop yield declined.

Social Organization

We hoped to find in the recovered artifacts evidence of the social organization of the people who built and inhabited Antelope House. Our social organization model is rather simplistic and rests on the following assumptions: (1) human behavior is patterned and structured and can be inferred from the material remains that once were an integral part of the behavioral system (Binford 1964, 1968; Heizer 1960: 115; Hill 1970a: 15; Longacre 1970; Struever 1968: 131); (2) no individual item or group of items can be considered in a meaningful manner unless eventually related to a cultural system, whose principal elements are ecological, social, technological and economic in nature (Binford 1964: 425); (3) these subsystems have material correlates, which relate to

each other as well as to the behavior which created them, and (4) the material culture may reflect the cultural system (Binford 1962: 217) and can hardly be understood apart from the environment in which the culture functioned. This, of course, is the archeological expression of the strategy of cultural materialism:

> The essence of cultural materialism is that it directs attention to the interaction between behavior and environment as mediated by the human organism and its cultural apparatus (Harris 1968: 659).

Confronted with an obvious architectural segmentation at the two room blocks within the site, we hypothesized that each unit might reflect the presence of a separate social unit, by which we mean a group similar to Rohn's (1971: 39) dual division or to Dean's (1969: 37) localized lineage. The assumption here is that these groups interact more within their membership than outside the group in most activities (Chang 1958; Beardsley et al 1956; Bullard 1962: 100). This interaction will be reflected in non-random clusterings of at least some attributes. Knowledge of clustered and non-clustered attributes may allow the development of models which more clearly specify the characteristics and membership of the group.

A problem lies in assessing the significance of the attributes selected for analysis. Given enough attributes and enough analyses, an investigator can surely come up with something which clusters. Use of the behavioral chain allows a selection, albeit rudimentary, of the critical attributes and behaviors utilized for comparison. The behavioral chain, or the sequence of all activities in which an element participates during its "life" within a cultural system (Schiffer 1973), may contain several activity sets; these in turn, may be comprised of several segments or behaviors.

The behavioral chain is useful, in conjunction with other models, for comparing systemic context statements and hypotheses with objects in archeological context (Schiffer 1972: 157). Very briefly, Antelope House can be viewed as the accumulated residue of the operation of innumerable behavioral chains within a cultural system. This material has been deposited as primary (discarded at place of use), secondary (transported and discarded) or de facto (undiscarded) refuse (Schiffer 1972: 162). This mass has been acted upon by a relatively small number of natural processes to produce the data which the archeologist must manipulate to conduct his research. In effect, we proceed from the archeological deposit to the behavioral chain and a level of abstraction at which we can discuss the operations and changes of the cultural system, i.e., the systemic context.

In the execution of the analyses developed for studies of social organization, each investigator developed his own concepts and model for his own study. In each of the analytical chapters below, different terminology is used. The different models are summarized, synthesized, and evaluated in Chapter 28.

Survey

Although the project was directed toward the excavation of a single site for interpretive purposes, it became obvious as work progressed that interpretation was hindered by a lack of data on the distribution of sites in the Canyon del Muerto region, particularly in the area surrounding Antelope House. Midway through the 1971 season, we launched a small scale survey directed toward locating and recording sites in Canyon del Muerto within a two-mile radius of Antelope House. The areas above Antelope House on either side of the rim were also examined for prehistoric sites. Navajo period sites, as well as Anasazi sites, were recorded.

Sampling

Before fieldwork began, the research design called for a randomly derived sample of excavated rooms, but conflicts arose between this goal and the need to remove backdirt, to clean the area around the ruin and to stabilize the walls. A random sampling scheme was abandoned, in order to lease the site suitable for visitation. It should be emphasized that this decision mattered only in the short–term results, since from the beginning, it was expected that the majority of the site would be excavated.

Unexcavated material was left in each major section of the site (Fig. 1) in order to provide future investigators with opportunity for research, while displaying most of the pueblo to the public. The undug areas in the Central Plaza

and North Room Block were selected to leave complete columns, capped by the original surface, *in situ*. Rooms 78 and 10 in the South Room Block were left unexcavated, with minor excavations in Rooms 2, 3, 9, 10 and 22. This decision was shaped by interpretive demands, rather than by sampling procedure. The investigator of the future can hope to find intact several room floors; these were built in successive intervals during the Pueblo III period and, according to our architectural analysis, should provide a coherent excavation unit. The southern portion of the Central Plaza beyond the "D" grid line was left unexcavated.

The majority of the fill found within the pueblo comes from the South Room Block. It is hardly surprising, therefore, that most of the artifacts come from there, too. We have attempted to compensate for this by standardizing the data in terms of number of occurrences per excavation unit or a similar measure.

It is obvious that excavation can sample only what remains at the site. We know that much of the site, particularly to the northeast, was removed by flooding and we assume, in the absence of data to the contrary, that the archeological record that remains is representative of the whole. This means, of course, that Antelope House is far from an ideal site for investigation of many topics.

Many indications, from the common ocurrence of deeply stratified sites in the canyon to casual observation of the fill at Antelope House, sugested a long occupation of the site. Tests throughout the site, which reached Basketmaker III levels, confirmed these expectations. Between the masonry pueblo and the Basketmaker III structures and refuse were the remains of an extensive Pueblo I village.

Given the original intent of the project, we paid little attention to these earlier occupations, generally concluding excavations when we reached the bases of the walls of the pueblo unit. Occasional sub-floor tests were conducted, but most of the information on the earlier occupations comes from the eastern face of the site, where excavation of these levels was easy. More

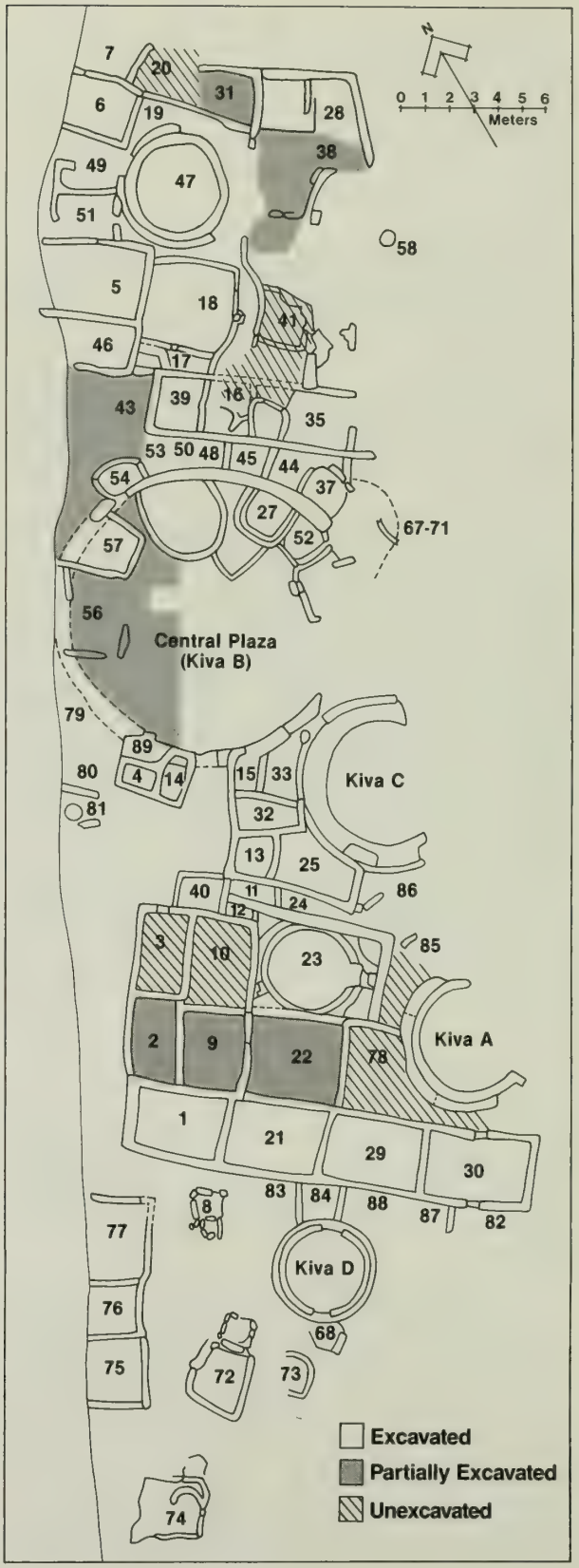


Figure 1. Plan of Antelope House after excavation, showing areas left unexcavated.

extensive investigation of these occupations would have needlessly endangered wall stability. Since several sites throughout the canyon area represent these time periods in more easily excavated situations, we did not attempt to systematically secure data on these earlier levels.

Excavation Sequence

A map of the site was prepared prior to excavation, using an alidade and a transit. The map recorded the exact elevation and location of all visible walls, as well as the contours of the area on which the site is located. While the map was being prepared, the site datum point was established at 1752.267 m above MSL and tied to the Canyon del Muerto Survey. An arbitrary grid of five-meter squares was laid out over the site (Fig. 2), providing a means of control for spatial distribution of the materials recovered during excavation. The arbitrary grid was maintained throughout excavation, however, only where natural or cultural features were not available for use as space designators. For example, the grid was used until a room was recognized, at which point the room walls replaced grid squares as bounding units. Once the mapping project was complete, all surface features—walls, rock art and other objects—were photographed to record the exact condition of the site prior to excavation (cf. photographs 1906, 1970, 1974).

After a photographic record of the site's physical condition was made, unsound walls were stabilized. By capping the high walls of Rooms 1, 3 and 10 and, where possible, anchoring them to the cliff wall with reinforcing tie rods, the area near them was made safe for excavation. The east and south walls of Room 3 and 10 looked as if they still stood at their original height, they were capped by resetting the upper two original masonry courses after placing reinforcing wire. Repair and stabilization were done with original materials. Stones found at the site were placed as stable caps on walls, following original architectural style but using a waterproof portland cement core. The stones then were grouted with mud made from the abundant adobe mortar fragments at the site.

During the first field season (1970), the sections of the site thought to be in need of immediate stabilization were worked on. Excavation began in the north half of the site and in Rooms 1 and 9 in the south half. The testing procedure continued in areas within the site and adjacent to the building complex as the investigation progressed.

The most intensive excavations were conducted in 1971. Stabilization during this year was not emphasized. Twenty-one rooms in the South Plaza and the South Room Block were investigated by test trenching and full excavation. A test trench was cut into the South Plaza area, allowing stratigraphic analysis and yielding a great deal of information about the variety of uses to which the area had been put. Burial 5 was recovered at this time. The Central Plaza was entered and Steen's previous trenching (see Chapter 3) of the area was reexamined. The northern portion of the site also was excavated to a significant extent.

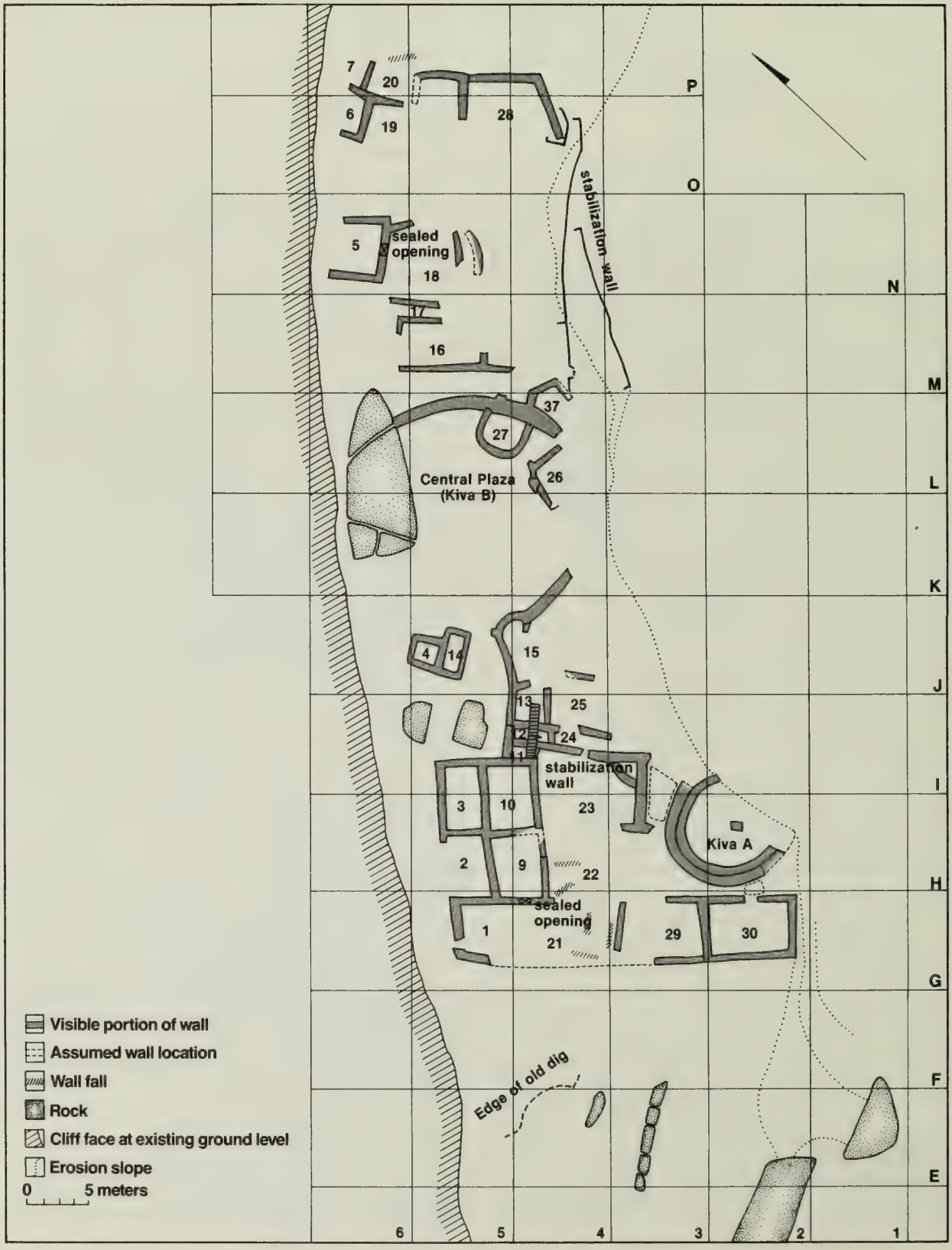
The 1972 season, which also emphasized excavation, focused on defining the composition of the pueblo itself. Rooms 1, 29 and 30 of the South Room Block were excavated, as was the South Plaza, where excavation was expedited by the use of a backhoe to remove the back dirt and overburden resulting from Palmer's 1906 work (see Chapter 3). Work on the North Room Block focused on Rooms 5, 47 and 67. Structure 67, one of the most informative structures excavated, is situated on the eastern edge of the North Room Block. Dendrochronological dates demonstrated the time of construction of this pithouse and archeomagnetic samples from the hearth and floor documented the time of the fire that destroyed it.

The Tower Corridor and Central Plaza were excavated during the summer of 1973 and new walls were stabilized as they were exposed. In this, the last field season, excavations begun in previous seasons and stabilization were completed. Test trenching in the South Plaza was expanded into the D–3 square (Fig. 2). This test trench reexamined the stratigraphic sequence of the site for information about its earliest occupation, but the water table was reached before excavation reached sterile soil. As the season was completed, a trail was placed through the site for public interpretation and the site was remapped.

Method of Excavation

The excavation of Antelope House was carried out by a Navajo crew and a team of four professional archeologists, who worked with and

Figure 2. Plan of Antelope House before excavation, showing grid layout.



supervised the crew. Task assignments for the individual archeologists, including administration, coordination, record keeping, mapping and laboratory supervision, varied over the seasons.

A major objective of the excavation was the isolation and identification of "natural" layers within the stratigraphy. It was assumed that isolation of these strata within rooms of similar units would yield cultural and developmental information of a more critical nature than would arbitrarily imposed levels. Where the perceived layer was unusually thick (i.e., in excess of 50 cm) or where a fairly thick layer seemed to be resting on a floor, arbitrary division were employed to improve analysis. It was typical when dealing with a thick floor contact layer to split the lower 5 to 10 cm of refuse into a separate unit.

The horizontal unit generally was the interior of a room. In situations where one was digging outside a room or where one was unaware of digging within the confines of a room, the bounding unit employed was the appropriate grid square.

The site in this way was taken apart in a series of units, typically bounded by room outlines and delineated by some perceptible difference in color, comparison or texture. These fill units were termed proveniences and each was given a separate number. Records of the composition of these proveniences were logged numerically in our field notes and in a provenience log, in order to keep track of their variation during analysis.

This three or four digit number is adequate to relocate material recovered from the deposit. The room number usually was placed with the provenience number, so that a typical tag would read "Rm 1, P 331." If using the grid system, it was mandatory to give the meter unit designation, e.g. P245 (123). Use of the capital "P" or circling the provenience number are conventions adopted to clearly identify the numerals as proveniences.

After the first season, Provenience 000 was assigned to surface finds or to material for which context was no longer certain. We adopted the practice of assigning each archeologist blocks of one hundred numbers each, making it possible to identify the excavator of the unit.

The excavation recorded some 1,300 distinct proveniences. These ranged in size from very small units, such as the interior fill of a posthole or a ceramic vessel, to extremely large units, often covering several square meters in the more open portions of the site.

The first step in excavating a room was to produce a vertical face cross section in the room fill. This usually required a trench across the room. Where a portion of the room had been eroded away, however, one could simply face the fill. Provenience units were assigned as stratigraphic differences were defined in the excavation of trenches and test pits. By examining cross sections of a unit, it was possible to detect more fine-grained stratigraphy than would have been possible with other excavation techniques. These natural units were identified and removed piecemeal from the fill of the room. The trench typically was excavated to a depth of 50 to 100 cm, or until the excavator reached a floor or some sort of hard surface. Thus, all fill above the floor surface could be examined at one time and the stratigraphy could be followed throughout the unit being examined.

After examining the stratigraphy and selecting the units to be excavated, the units were removed (usually using a trowel) and the fill was shoveled into wheelbarrows and removed for screening. When possible, a pollen sample and a flotation sample were taken from each stratigraphic unit. The workmen excavating the unit removed fragile and perishable field specimens as they placed the fill in wheelbarrows. The remainder was taken to an inclined double-tier screen (Bird and Ford 1956), where it was screened and sorted. A ¼-in. screen and window screen were used. The several different proveniences being excavated were kept separate through the use of pre-numbered tags.

To insure consistency of screening, all proveniences were sorted and collected by the same screen operator. Using this method, all lithic, ceramic, bone, vegetal and fecal materials recovered were retained. In situations where feces such as turkey dung or sheep dung constituted a large part of the fill, only a sample was retained. Rough calculations suggest that as much as 35 percent of the original volume of dry proveniences was preserved for analysis.

The selected material was taken to the field laboratories, where it was sorted into finer categories for analysis (Table 2) and boxed for shipment from the field. Due to the excellent pres-

ervation at Antelope House, which provided large quantities of such perishable materials as sandals, textiles and baskets, the sorting and categorization often was quite complex.

Table 2. Field laboratory sort categories.

1. Basketry and Matting	15. Ground stone
2. Bone	16. Knotted yucca
3. Charcoal	17. Lithics
4. Corn cobs	18. Miscellaneous (metal, shell, etc.)
5. Corn stalks, husks (knotted)	19. Pollen samples
6. Corn (other)	20. Quids
7. Cotton	21. Sandals
8. Cordage	22. Seeds
9. Dendrochronology	23. Sherds
10. Feathers	24. Soil samples and clay samples
11. Feces	25. Textiles
12. Fiber	26. Vegetal artifacts
13. Flotation	27. Vegetal (generalized)
14. Gourds	28. Vessels (whole)

Chapter 3

Previous Research

Antelope House has drawn the attention of travelers and scientists for nearly 100 years. The resulting research has both disturbed the archeological record and preserved valuable information about the previous condition of the site. Much of this work is not well documented and some is published here for the first time. The early photographs of Antelope House proved of far greater value to us than did the early written descriptions.

Early Period: 1849 to 1920

Lt. James Simpson's (1850) account of Canyon de Chelly and its archeology does not mention Antelope House. It appears, in fact, that he was unaware of the existence of Canyon del Muerto as he traveled into Canyon de Chelly from its mouth to well above White House. No mention of del Muerto appears in expeditionary accounts until the Kit Carson campaign of 1864, when Capt. Albert H. Pfeiffer blundered into the canyon at its head, descending to its junction with de Chelly and on to Chinle. Between skirmishes with the Navajo, he recorded the existence of several castles, or villages, one of which he named Castle Carey (for Capt. Asa B. Carey, a fellow officer on this campaign). Pfeiffer described the castle as high up among the rocks and solidly built (U.S. Government 1891: 71). His description and his position about halfway down the canyon suggest that Castle Carey is Mummy Cave. Although Pfeiffer marched past Antelope House on January 13, his third day in the canyon, he made no specific mention of the site.

James Stevenson's work in Canyon de Chelly in 1882 began the era of scientific investigation of the canyon's archeology. Although Stevenson's early reports (Stevenson 1886a, 1886b) do not mention Antelope House specifically, a later publication by Cosmos Mindeleff (1897) provides much valuable data on the site, including the first photograph and map. Mindeleff, who collected the site, classified Antelope House as a "Home Village on Bottom Land," a type characterized by large size, the presence of kivas, location on the canyon floor and, inferentially, by long occupation. His description is quite accurate:

> Plate XLV shows another example in del Muerto, *the largest in that canyon*. The walls are still standing to a height of three stories in one place, and the masonry is of high class. The back cliff has not entered into the plan there to the same extent that it generally does. Figure 2, a ground plan, exhibits only that portion of the area of the ruin on which walls are still standing. It shows about 20 rooms on the ground, exclusive of three or perhaps four kivas. The rooms are small as a rule, rectangular, and arranged with a more than ordinary degree of regularity. *One room still carries its roof intact*, as shown on the plan. In the center of the ruin are the remains of a very large kiva, over 36 feet in diameter. It is now so broken down that but little can be inferred as to its former condition, except that there was probably no interior bench, as no

> remains of such a structure can now be distinguished. The size of this kiva is exceptional, and it is very probable that it was never roofed. The structures within the kiva, shown on the ground plan, are Navajo burial cists. West of the large kiva there were two others, less than 20 feet in diameter. One of these was circular, the other was irregular in shape, perhaps more nearly approaching an oval form. At no fewer than five places within the ruin there are comparatively recent Navajo burials [emphasis added].

Information on Antelope House at the turn of the century comes primarily from photographs made by photographers Adam Clark Vroman, Edward Curtis and others. The Day brothers, who had established a trading post at Chinle, probably excavated at Antelope House, as they did at many other sites. F. M. Palmer stated, in what must be a comment on the Day brothers, "it (Antelope House), as well as all other accessible ruins in these cañons, has been effectively looted by various parties, who have been munificently rewarded for the acts of vandalism by being able to dispose of their spoils for many thousands of dollars—Eastern Museums and professedly scientific men being purchasers of the loot" (Palmer 1907).

Palmer, conducting the Second Arizona Expedition of the Southwest Society (Anon. 1907), photographed, mapped and excavated in the ruin beginning in June of 1906. From photographs of the excavation, it is evident that Palmer dug extensively in the South Plaza, recovering 12 burials in the process. He completely excavated Kiva A and must at least have tested other rooms, as he states, "I excavated a number of rooms . . ." (Palmer 1907). His report inventories what appears to be a typical sample of the material culture of Antelope House. Unfortunately, most of this material, along with notes and photographs, has been lost. A great deal of our information on Palmer's work comes from a photograph album donated to the National Park Service in 1970 by Kathleen V. Brokaw, the daughter of Virgil White, Palmer's photographer.

Late Period: 1920 To Present

Earl Morris, whose work in Canyon del Muerto is associated primarily with his search for Basketmaker material in Mummy Cave, Battle Cove, Big Cave and elsewhere, excavated briefly at Antelope House in 1923 (Bernheimer 1923, 1924), 1926 and 1929. During the last season, he excavated and removed eight burials, most of them from the area near the upright leaning slab which bounds the South Plaza. He also excavated the spectacular Tomb of the Weaver, located across the canyon floor from Antelope House at Battle Cove (Morris 1948). Morris did not consider this burial to be related to Antelope House because the Weaver was interred with Mesa Verde vessels, a type which Morris did not find at Antelope House. His opinion now must be reevaluated in view of the considerable percentage of Mesa Verde pottery recovered from Antelope House.

At various times during the 1920's and later, tree-ring samples were taken from the site by Deric O'Bryan and Earl Morris, among others. At the time our project began, the two published dates for Antelope House, 828r and 838v (Bannister, Dean and Gell 1966: 25), indicated that a Pueblo I occupation would be found beneath the Pueblo III masonry.

In October of 1941, Charlie R. Steen of the National Park Service stabilized the east wall of Room 3, filled some breaks in Kiva A, built two retaining walls at the eastern edge of the North Room Block and trenched the Central Plaza to determine whether it was a great kiva. Steen concluded that this area, and, by inference, the entire site, had been highly disturbed and mixed by Navajo use, a conclusion not borne out by our excavations in the same area. A report (Steen 1942) described the excavations and the artifacts recovered from the site.

Stabilization by the monument staff in 1946 included closing holes in the east wall of Room 10 and construction of the retaining wall at the outside northeast corner of Room 10, measures which greatly strengthened the spectacular masonry.

Gordon Vivian stabilized Antelope House extensively in 1956, installing iron bracing in the fourth story of Room 10 as a temporary expedient. Vivian also patched holes and precarious walls throughout the site. His room numbers correspond to ours as follows:

Antelope House Project Room Numbers		**Vivian's Report** (1956)	
Room 1	Room 12	Room 3	Room 7
Room 3	Room 26	Room 5	Room 10
Room 10	Room 27	Room 6	Room 11

The National Park Service began stream channel stabilization efforts near the site in 1942, 13 years after establishment of Canyon de Chelly National Monument, with plantings of willow and cottonwood. The work undoubtedly constituted the most significant step ever taken to preserve Antelope House. Sometime before 1882, however, Antelope House was damaged by massive erosion of unknown extent, which concentrated at the eastern edge of the site.

The early photographs of the site, exposed by Ben Wittick and Adam Clark Vroman, demonstrate a remarkable stability at Antelope House. The roof Mindeleff mentions presumably covered our Room 5, but it disappeared very soon after he recorded it. With this exception, one is impressed by the lack of substantial damage to the architecture of Antelope House over this very long period, due to early stabilization of critical areas and to tree planting along the front of the site. The various excavations in the site, particularly those undertaken before 1920, have removed some of the archeological record, but there was much more undisturbed material in Antelope House than expected.

The photographs are extremely helpful in documenting the extent of the excavation by Palmer (Fig. 3) and the presence of a pilaster in Kiva

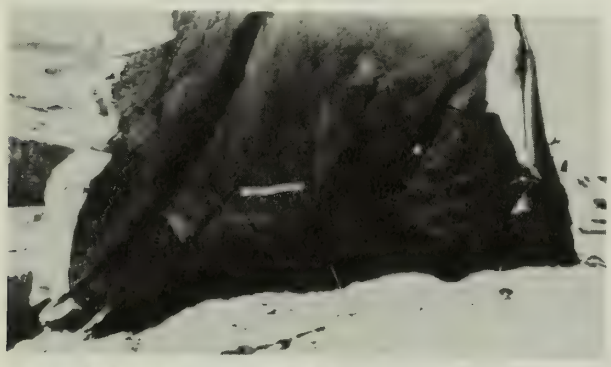
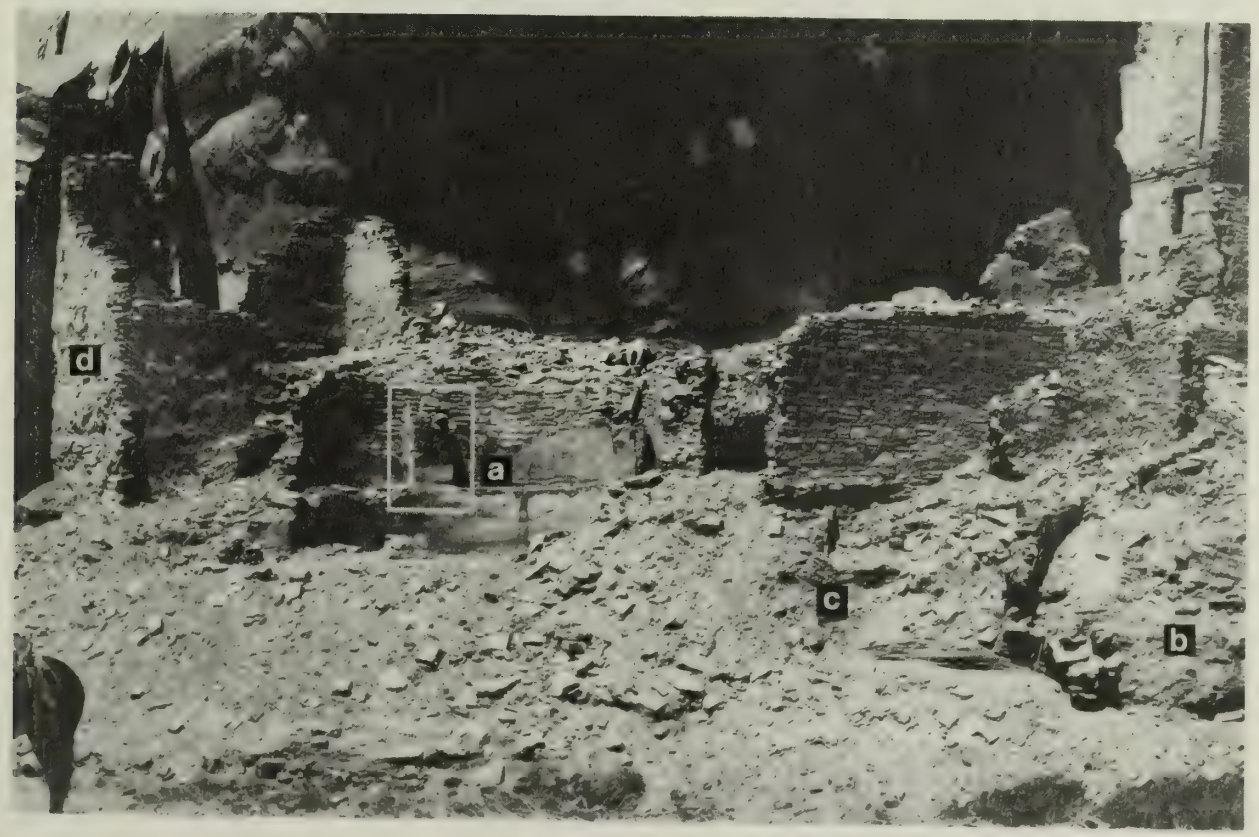


Figure 3. The South Plaza under excavation in 1906. The area at lower right was still undisturbed at the beginning of our project.

Figure 4. This photograph of Antelope House as it appeared about 1906 is the only evidence for the existence of a pilaster in Kiva A (a). Kiva C (b) is clearly visibile, as is Room 86 (c). Note the unbreached east wall of Room 30 (d). (Photo courtesy Los Angeles County Museum)



A, which Palmer excavated in 1906 (Fig. 4). This pilaster now is missing from the site and this photograph is the only evidence for its existence.

Evidence for wall collapse also is visible in Figure 4. Most of the north wall of Room 18 has collapsed, as has part of the east wall of Room 25. Much less wall rubble is present on the ground, due in part to stabilization activities and probably to hogan construction; the white plaster on the north exterior wall of Rooms 10 and 3 is clearer than in more recent photographs. A wall in the vicinity of Rooms 56, 57 or 79, which has collapsed, was standing in 1904 (Fig. 5).

Photographs of the South Room Block indicate amazingly little change in the high fragile walls found there (Fig. 5, 6 and 7), due largely to the preservation efforts of Steen and Vivian. Minor damage to the east wall of Room 30 is evident when Figure 8 is compared with Figure 9. The breach in this wall appears to be a pothunter's hole, probably made to gain access to Burial 2, a Navajo period burial.

Figure 10 (date unknown) shows major deterioration. The former north wall of Room 18 is prominent in this picture; it is clear that the wall contained two wall segments, only one of which stands. The missing wall segment may have been built by the Navajo, but this seems unlikely. The photograph documents that the room enclosed by this wall stood above ground and was one story high, which is significant, since this room was a square kiva. The wall in the background of Figure 10 is on the edge of a badly eroded section of the site, from which it fell some time ago. The wall seems to be the east wall of Room 25 (WS 65). The photograph also presents an exceptionally clear view of the row of triangles on the north wall of Rooms 10 and 3.

The lush vegetation now present at the site tends to obscure features which were more visible before the planting of cottonwoods and willows. Figure 11, for example, shows a panel which was conspicuous from the canyon floor early in the century, but which is now almost

Figure 5. Antelope House as it appeared in August 1904. The south wall of Room 25 is seen end-on (a). A portion of a wall belonging to Room 57, 56 or 79 (b) is visible behind the north wall of Room 28. The north wall of Room 23 (c) was more complete in 1904. This photo was taken from nearly the same location as was the earliest published photo of the site (Mindeleff 1897); note that the south wall of Room 9, visible in the 1897 photo, had disappeared by 1904. (Photo courtesy Los Angeles County Museum)





totally screened from view. Whether this panel showed conspicuously in the pre-historic past obviously is dependent on the amount of vegetation in the immediate vicinity of the site, a situation which we are unable to reconstruct; it seems probable that the site was relatively bare.

These photographs document gradual deterioration of the masonry at Antelope House, some pothunting and removal of stones. Above all, however, they document the stability of some extremely fragile construction and the existence of otherwise undetectable features.

Figure 6. The man is standing in Room 10, South Room Block, as it appeared in August 1904. Note the now missing coping in the upper-story doorway between Rooms 10 and 3 (a) and the bird motif on the wall adjacent to the lower-story aperture (b). There was more wall rubble on the ground in 1904 than later.

Figure 7. This photo by Adam Clark Vroman shows the South Room Block as it appeared in August 1904; this section of the site changed little during the ensuing 60 years. Note the now missing burial cairn (a) in the northwest corner of Room 1.

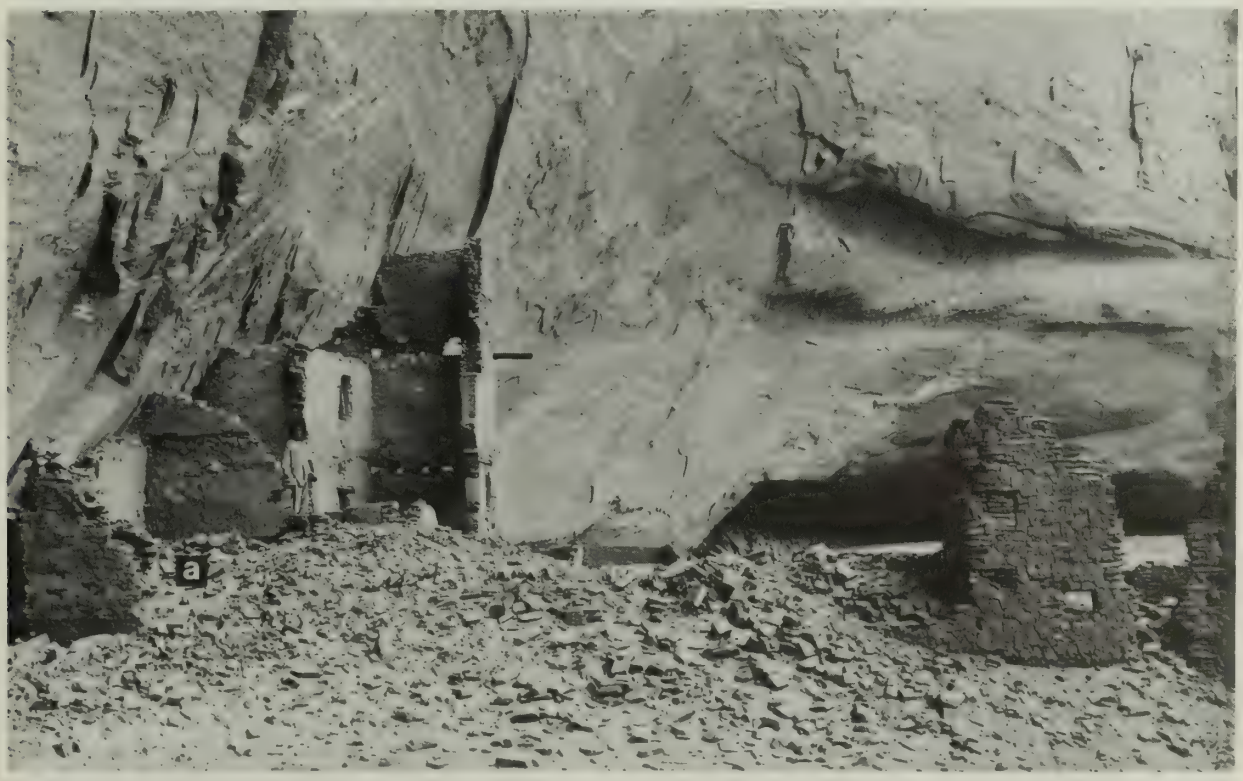




Figure 8. This photo of the site in 1905 shows the unexcavated Kiva A (a) and an aperture in the east wall of Room 25 (b), which has since collapsed. The unbreached east wall of Room 30 (see also Fig. 4; cf. Fig. 9) is seen at left (c). (Photo courtesy Museum of Northern Arizona)

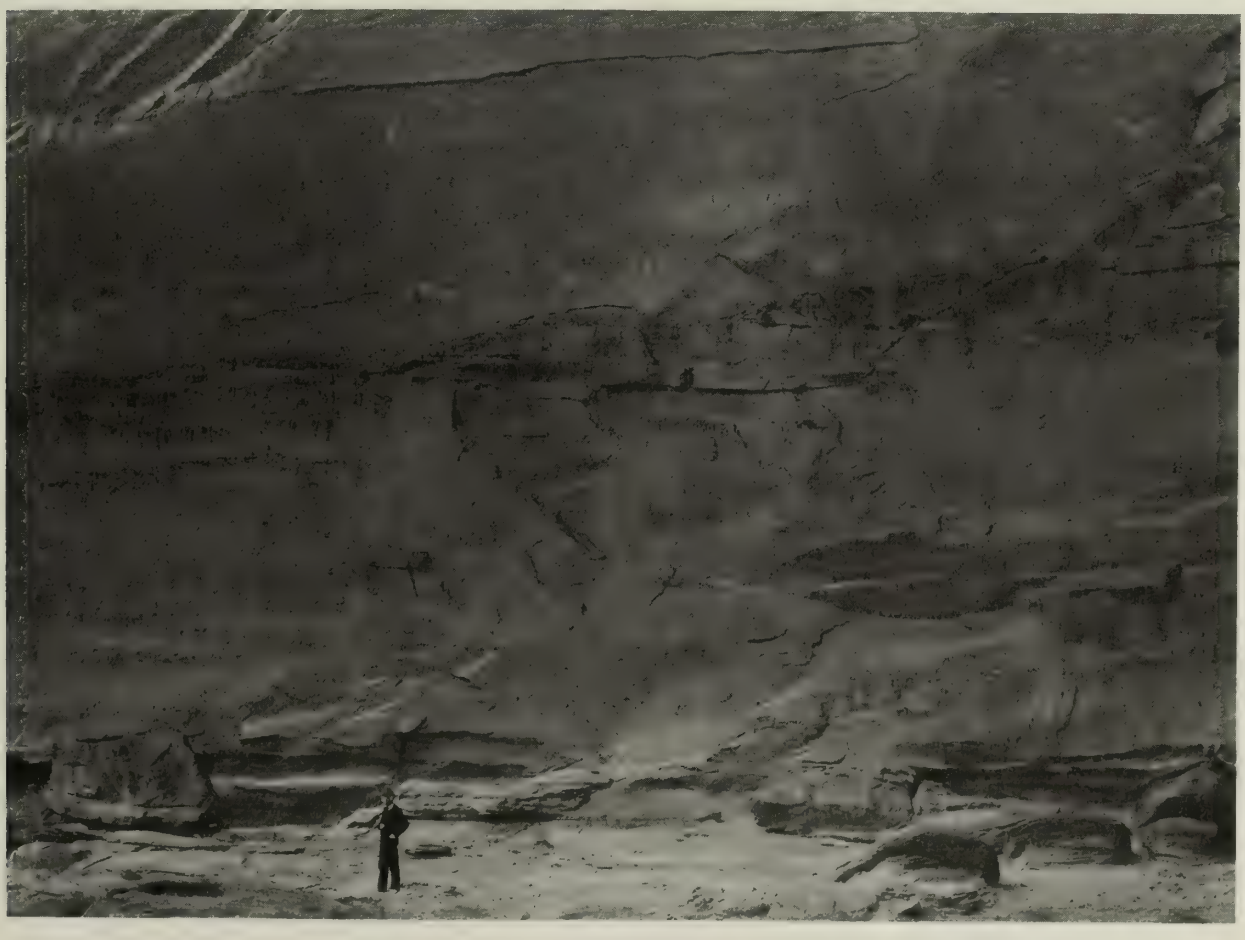
Figure 9. The South Plaza as it appeared before the start of excavation in 1970.



Figure 10. This photo of the site was made sometime prior to 1923. The north wall of Room 18 (foreground) was more complete then than now. This photo suggests that the wall was built of two clearly definable wall segments; the later segment has since collapsed or been removed. The white plaster and the triangular motif on the north wall of Rooms 10 and 3 (background) are clearer than in more recent photos.



Figure 11. An early photograph of the pictograph panels south of the South Plaza. The date of the photo is unknown, but it must have been taken before 1940, as the vegetation which now obscures this view of the ledge is absent.



Chapter 4

The Settlement Pattern Survey

Objectives of the Study

Because of the site's size and location, a survey was designed: (1) to test the **hypothesis** that Antelope House was a center for surrounding contemporary sites; (2) to delineate, if present, **population aggregation** in the area of the site during Pueblo III times, and (3) to discover the **access routes** from Antelope House to the plateau.

The Hypothesis

The hypothesis that Antelope House functioned as a center for surrounding contemporary sites developed from two observations: (a) the site obviously is larger and more imposing than many of its neighbors (only Standing Cow, which is 69 percent as large as Antelope House, approached the site in size); and (b) the site contains a large circular structure, somewhat like a great kiva.

A localized survey was implemented to test the hypothesis, since no data were available for that purpose. Although we were interested primarily in questions about the Pueblo II (P II) and Pueblo III (P III) occupations at Antelope House, we attempted to record all archeological sites, including Navajo structures, within a two-mile (3.2 km) radius of the site, the arbitrarily defined limits of the study area.

The very large sites in the de Chelly area, those similar in size to Antelope House and Standing Cow, have been well known for years. We include in this category sites containing more than 1500 square meters: White House (pre-erosion), Sliding House, Mummy Cave, Wild Cherry Ruin and Tse-ta'a. Larger sites generally are situated at wide intervals within the canyon system, Standing Cow and Antelope House being closest together.

Although the comparison of excavated versus unexcavated sites introduces an obvious bias, the greater relative size of Antelope House is confirmed for the Pueblo I (P I) and Pueblo III stages, but not for Pueblo II. The data indicate that Antelope House achieved a distinctively larger size during P I, that it can be considered relatively small during P II and that it expanded greatly during P III.

Correlating with Antelope House's locally distinctive size is the unique architectural feature of the Central Plaza, construction of which is dated to AD 1200 or slightly later. The open, unbounded plaza which preceded it may have served the same function.

If our hypothesis is correct, smaller settlements of more limited function than Antelope House should occur in the surroundings area. This is particularly likely to be true of ceremonial structures. Smaller sites should exhibit some tendency to cluster near Antelope House, although canyon topography may interfere with any tendency toward a well–defined cluster.

Population Aggregation

Since aggregation of population in fewer and larger sites during P III times has been observed throughout the Southwest (Lindsay 1969: 218; Martin and Plog 1973: 208; Jett 1964), we felt that a local survey should be able to delineate this trend by recording a number of P II sites and by demonstrating their coalescence into a smaller number of P III units. Before discovery of P II occupations of Antelope House, we were also concerned with locating some examples of P II dwelling units.

De Harport's earlier survey of Canyon de Chelly, the only discussion of site ecology, settlement pattern and population dynamics in the area, stimulated several questions about site clusters, community organization and population growth. Of particular interest was the fact that de Harport found no data reflecting noticeable aggregation during P III times.

Plateau Access Routes

Since it was readily apparent that many materials in use at Antelope House probably came from areas of the plateau, we are interested in learning of the access routes from Antelope House to that area. Exactly how difficult was it for the population of Antelope House to reach the plateau? Did the canyon constitute a barrier which restricted the movement of the Antelope House population? Or was it merely a tiresome climb to the plateau?

Method

Each site was entered, past experience having shown that the number of rooms recorded is approximately doubled when the investigator enters the site, rather than recording what is visible from outside the alcove. Satisfying this condition required everything from relatively easy scrambling to intricate rock climbing. In some cases, especially on thickly vegetated ledges, sites would have been overlooked had the area not been entered.

Architectural features and rock art were recorded in both color and black-and-white 35 mm photographs. Measured sketch maps of sites were also produced. Grab samples of sherds were collected from each site, although recent sheep dung layers and scavenging by visitors precluded the collection of an adequate sample in many cases. Notes were made of each site's environmental setting (including plant communities), site/shelter orientation, mode and ease of access, indications of site function, construction or architectural details, tree-ring and archeomagnetic dating, archeological potential and other items of interest. Site size is the approximate area covered by cultural material. If datable material existed, a second trip often was made to recover specimens. Data are filed at the Western Archeological Center, Tucson, Arizona, where they are being computerized.

Utility of the Data

Limited funds eventually caused us to abandon total survey of the region within a two-mile radius of Antelope House, prompting us to place more emphasis on survey of the canyon than of the plateau. This decision was made because it was clear that the period of occupation best presented in the Antelope House excavations, Pueblo III, was essentially absent from the plateau and that the population for that period was clustered within the canyon. This is based on the findings of the right-of-way surveys conducted by the Museum of Northern Arizona for the Chinle-Tsaile road (Charles James 1974: personal communication) and of the survey of the scenic spur roads from this highway (Stacy and Morris 1972). Two of these roads are within our survey area and serve as sampling transects for the plateau.

While these data permit only intuitive conclusions, they are being confirmed by more rigorously designed survey samples. Our discussion stresses the Pueblo III situation, since data from both Antelope House and the surrounding region are deficient for the earlier time periods.

Prehistoric Sites

The sites identified near Antelope House are dated as in Table 3, in terms of the Pecos chronology. Dating is based essentially on ceramic types, architecture and masonry style and, where available, tree-ring dates. Appendix A contains site descriptions and the evidence for dating of Pueblo II and Pueblo III sites.

Analysis

The only study of settlement pattern in Canyon de Chelly was done by de Harport, who studied Canyon de Chelly communities from Basketmaker II through Pueblo V. By communities, he meant physical clusterings of sites of

Table 3. Habitation sites located and their dates.

Basketmaker II	CDM 6 —Ute Raid
CDM 7	CDM 7 —Battle Cove
CDM 28	CDM 10—Antelope
CDM 99	CDM 20
Basketmaker III	CDM 28—Sonic Boom
CDM 10—Antelope	CDM 30
CDM 18	CDM 125
CDM 28	BLR 6
CDM 115	NRM 26
CDM 116	**Pueblo III**
Pueblo I	CDM 2 —Ledge
CDM 3 —Black Bull	CDM 3 —Black Bull
CDM 10—Antelope	CDM 4 —Standing Cow
CDM 28—Sonic Boom	CDM 6 —Ute Raid
CDM 57	CDM 9 —Standing Rock
CDM 74	CDM 10—Antelope
Pueblo II	CDM 11
CDM 2 —Ledge	CDM 13
CDM 3 —Black Bull	CDM 14
CDM 4 —Standing Cow	CMD 20
	CDM 28—Sonic Boom
	CDM 30
	CDM 42
	CDM 113
	CDM 125
	BLR 1

the same time period. He detected no clustering during the Pueblo III period (de Harport 1959: 1558), when most sites were concentrated in upper Canyon de Chelly. Most of these were ramadas and presumably were occupied in the summer, indicating an agriculturally related seasonal population movement—downstream in the winter, upstream in the summer.

Many of de Harport's sites contain both Pueblo and Navajo ceramics, which he generally interprets as a double occupation. Similar sites are recorded elsewhere in the region (Stacy and Morris 1972). Excavation of sites with mixed assemblages generally reveals them to be Navajo, with a scattering of Pueblo sherds collected by the Navajo for ceremonial activities (Hill 1938) or for ceramic production (James 1974). CDC 232, a site at which de Harport recorded Anasazi Black-on-white sherds and which he considered to contain a P III component, has been tree-ring dated to the late 1700's (Morris n.d.). The site is typically Navajo; only the ceramics indicate Anasazi use of the site. Photographs from the late 19th century show the site still in use.

More intensive analysis of some of de Harport's sites shows that the presence of Pueblo ceramics and of a well mixed late assemblage does not correlate well with Pueblo occupation and use of the site. At least some of de Harport's Pueblo III ramadas may be much later and the concentration of these sites in the upper canyon may be illusory. His hypothesis remains unproved, with recent research tending to refute it.

Pueblo III sites near Antelope House vary in area from 2 m^2 to 2500± m^2. The larger sites contain different features and floor plans than do many of the smaller sites, suggesting specialization of use and function. The larger sites, typified by Antelope House, contain a full array of storage nooks, habitation rooms and kivas. Many of the sites follow a generalized pattern of central open space flanked by room blocks. This pattern is clearest at Antelope House, Sliding Rock (CDC 107) and Mummy Cave ([CDM 174] a tower/kiva complex at Mummy Cave was constructed very late, probably by migrants from the Mesa Verde area). The central public area either does not appear or is not as formalized in medium-sized sites (those with areas approximating 750 m^2). Very small sites (CDM 13, CDM 14) clearly were used for storage. Many sites of moderate size resemble a room block such as those associated with larger sites. A kiva and habitation rooms usually are present if sufficient space is available in the rock shelter.

This array of site types, with the larger sites widely separated, suggests that larger units served as integrative centers for smaller units. The total complex interacted as a social unit, which probably controlled subsistence resources in the surrounding region. The situation may not differ greatly from that of any of the Western Pueblos in historic times, except in the use of rock shelters for habitation, a situation which in Canyon del Muerto demands a dispersed settlement pattern.

The data to test the existence of such territorial groups are not available, since only larger sites have been systematically excavated, and a site report exists for only one other ruin in the canyon (Steen 1966). Study of the rock art of the canyon area may reveal groupings of common motifs correlating with the spatial boundaries of such groups. In short, we can hypothesize that Antelope House served as an integrative center for its smaller neighbors, but the hypothesis cannot be tested fully.

Figure 12 through 16 locate, by period (BM II through P III), the sites we recorded. Both habitation sites and trails (Fig. 16) are shown.

Figure 16 shows that the Pueblo III habitation unit nearest Antelope House is the two-site cluster of CDM 28 and 4, more than a kilometer distant. CDM 20, CDM 14 and CDM 13, all of which appear to be limited activity sites, cluster in a large rincon 1 km downstream from Antelope House and are as close to CDM 6 as to Antelope House. CDM 2, CDM 6 and CDM 125 cluster together further downstream, while upstream clusters consist of CDM 28 and 4 and CDM 9 and 30. Each of these clusters is separated by approximately 2 km, with agricultural land between and available to clusters. As the site maps indicate, Antelope House is remarkable only in that the units are concentrated at one site rather than at two or more, as at the other clusters.

Antelope House approximates the more typical two-site cluster condition in Pueblo II times (Fig. 15), when the South Room Block and South Plaza of Antelope House were occupied, as was Battle Cove Ruin (CDM 7) just across the canyon. Like the early masonry of the South Room Block, the masonry of CDM 7 is predominately edge-chipped slab. Insofar as can be determined from available data, this site was abandoned at, or close to, the time that the North Room Block was constructed at Antelope House, and the size of CDM 7 approximates the size of the newly constructed North Room Block. Like contemporary masonry walls in the South Room Block, edge-

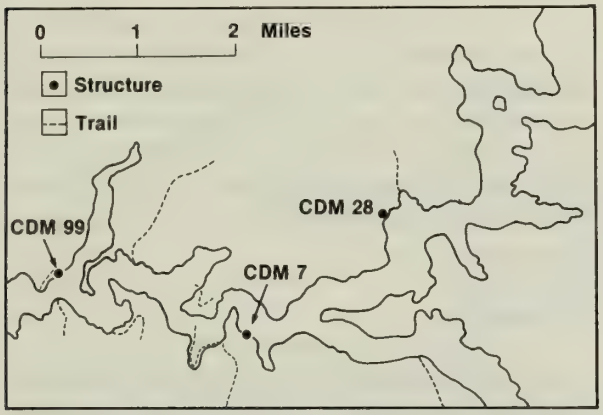


Figure 12. Basketmaker II sites recorded by the Canyon del Muerto Survey.

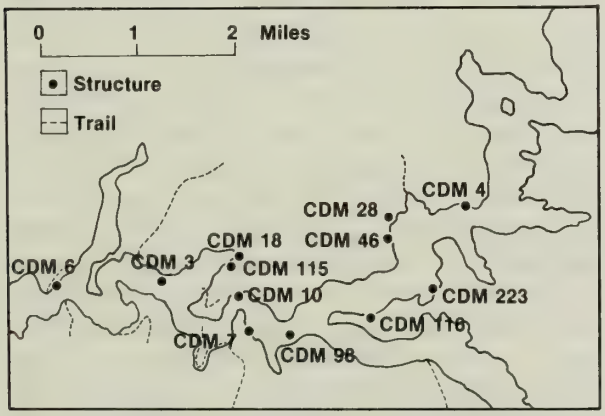


Figure 13. Basketmaker III sites, Canyon del Muerto.

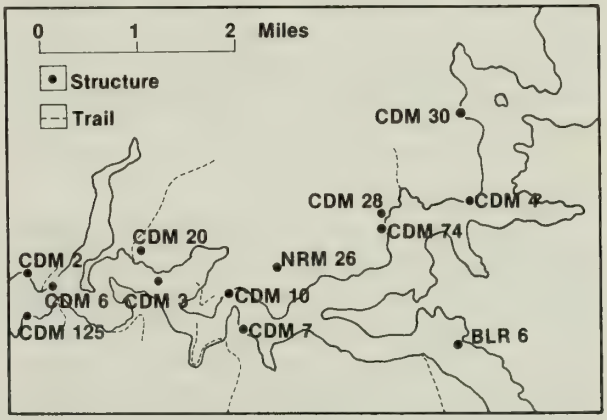


Figure 15. Pueblo II sites, Canyon del Muerto.

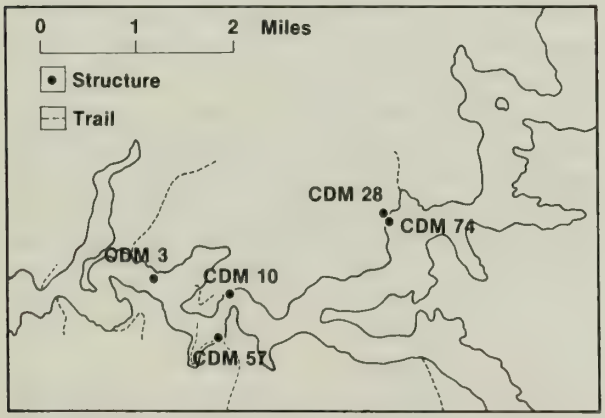


Figure 14. Pueblo I sites, Canyon del Muerto.

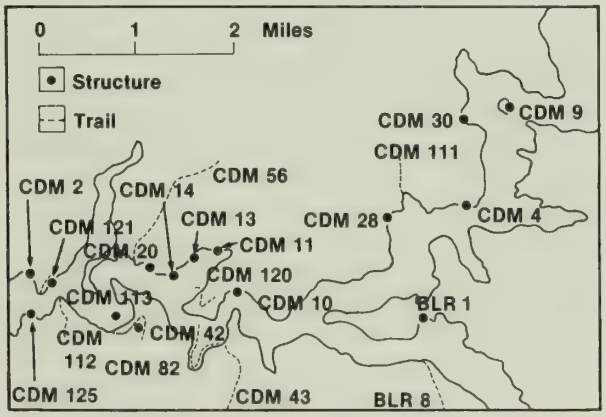


Figure 16. Pueblo II sites, Canyon del Muerto.

chipped slabs are less frequent in the earliest walls of the North Room Block. Neither unit contains rooms of more than two stories. Thus it is plausible that the population of CDM 7 moved across the stream to build the North Room Block around AD 1100. Future work at CDM 7 could test this proposition more thoroughly by intensive analysis of portable artifacts at the site.

The move across the stream would provide a specific instance of the tendency toward clustering of the Anasazi population into larger and fewer sites during Pueblo III times. In the area studied, this aggregation occurred only at Antelope House, as comparison of Figures 15 and 16 will show. This may simply reflect the fact that only Antelope House occupied an alcove large enough to permit noticeable aggregation.

Detection of similar tendencies elsewhere is difficult because the precise dating required is not available. On the basis of the sherd samples, CDM 6 and CDM 30 may have been abandoned after AD 1150, the beginning of the Middle P III period. This approximates the time that several sites on the plateau were abandoned, their populations presumably moving into the canyon. The basis for dating of abandonment is the lack of ceramics later than Sosi/Dogoszhi Black-on-white.

Trails and Access

Despite the initial impression that the steep-walled canyon offers no way out, a surprising number of access routes to the plateau on either side of the canyon is known (Fig. 16). For purposes of this discussion, it is assumed that any route used by the Navajo today could have been employed in the prehistoric past. The converse of this proposition is not accepted, since some trails with stone-pecked toe and handholds are not in use today; these are typically very steep, strenuous and somewhat hazardous routes. The more popular Navajo trails are situated in obvious breaks in the topography and are generally easier climbs; it is difficult to believe that Anasazi populations would neglect these easier routes.

Access to the peninsula is available via Antelope Trail (CDM 43), Many Ladders Trail (BLR 8), Bridge Trail (CDM 82) and CDM 112. The north rim can be reached via CDM 120, Baby Trail (CDM 56), Standing Cow Trail (CDM 111) and CDM 121. It is believed that additional routes may exist in the area, particularly abandoned Anasazi routes. Our knowledge of del Muerto trails suggests that this portion of the canyon is not at all unusual. Although the canyon is steep, it is only 178 m (585 ft.) deep at Antelope House.

When vehicular travel on the canyon floor was not possible, we utilized Baby Trail to reach the site and found it quite adequate. A trip from canyon bottom to canyon rim required no more than 10 minutes on this trail. It is difficult, therefore, to maintain that the canyon's steep walls would have been an obstacle to utilization of plateau resources.

Summary

Survey of the immediate vicinity indicates that Antelope House is the result of an unusually aggregated population in the Canyon de Chelly area. It is possible that the population of CDM 7 moved to Antelope House, there constructing the North Room Block in the early 1100's. Population clusters upstream and downstream from Antelope House are less compact, often consisting of two habitation sites in close proximity to one another. Each of the probable five clusters that can be detected in Pueblo III times would have contained approximately equal populations and each exhibits a comparable range of features. These data, then, tend to reject the hypothesis that Antelope House was a dominant center within Canyon de Chelly. It is unlikely that any dominant relationships existed among these population groups.

Access to areas outside the canyon was relatively easy, with numerous trails available. The canyon floor served as a well–watered conduit for foot travel east and west.

While de Harport's hypothesis of seasonal movement cannot be conclusively rejected, this analysis provides reasonable grounds for doubt. As we shall see, there is additonal evidence that suggests a year-round stable population for Antelope House.

Chapter 5

Overview, Methods and Observations

Overview

Even before excavation, Antelope House was an impressive example of the Pueblo architecture of the Canyon de Chelly region. In broad terms, the site consists of a multi-story South Room Block; a large circular central structure, which some have suggested might be a Great Kiva (de Harport 1959: 1544; Steen 1966: 46), and a North Room Block, which is about the size of the south block, but which contains smaller, more irregular rooms. To the north and the south are open areas containing trash, the cultural debris blending into arable land to the north. Immediately south of the south block is a triangular space, defined by an enormous rock slab propped against the wall of the cliff. This area, the South Plaza, was occupied extensively and shows evidence for much human activity. Extending beyond the South Plaza are more trash and pictographs; excavations were not conducted in this region. The western site boundary is the cliff face of the shelter; the eastern edge is the abrupt line of erosion (Fig. 2).

The area between the North and South Room Blocks contained rockfall and is the site of a massive-walled circular structure, known successively in field notes as "Kiva B," "Thing B," and, more prosaically, the Central Plaza, the label it bears in this report. Steen cross-trenched this structure to determine if it was a Great Kiva. He concluded (1942) only that the stratigraphy was greatly disturbed. Mindeleff (1897: 96) thought the smaller walls abutting this unit were of Navajo construction. We disagree on both points.

At the rear of the site, flanking the Central Plaza, are open areas; that to the south, we dubbed the Central Plaza Annex, and the one to the north was recorded as Room 43. Adjacent to the cliff face in the Central Plaza is Structure 81, whose artifact assemblage, carved wood prayer sticks, unusual natural stones and fossils convincingly fulfills the criteria for a Pueblo III shrine.

The stream has damaged the site to an unknown extent, but it is obvious that it has cut more extensively into the North Room Block. If Antelope House had a large trash midden to the front of the site, it was removed by erosion. When this erosion occurred is unknown, since it had reached its current stage by the time the first photograph of Antelope House was taken in 1882 (Mindeleff 1897: Plate 45).

Examination of the eroded face of the site showed Antelope House to be a deeply stratified site. Particularly clear stratigraphy overlay Structure 67, the earliest unit defined (Basketmaker III)

Method

The principal objectives of the architectural study of Antelope House were:

1. To develop a detailed internal site construction sequence, thereby assisting in the dating of archeological deposits within the rooms;
2. To characterize the architecture of the site in terms of the cultural historical sequence developed for the San Juan Anasazi (Wormington 1959; Willey 1966, Lindsay 1969; Dean 1969; Rohn 1971);
3. To develop population estimates for the period of occupation of the site;
4. To study variables hypothesized to relate to intrasite social organization (Hill 1970; Longacre 1970);
5. To define specialized activities areas for the site and to develop functional definitions for the rooms.

It was obvious that Antelope House, because of its dry condition, would yield considerable information on plastering, plastering sequence and wall construction. Since stabilization tends to obscure these details, pre-stabilization conditions were recorded in detail, generally in accord with the requirements established by the Ruins Stabilization Unit of the Southwest Archeological Center (Vivian n.d.). A second consideration was that the site and its architectural details would remain open to viewing both during the project and for an indefinite period thereafter.

In recording information in the field, we relied heavily on photography, supplemented by written notes; detailed notes were kept only on features destroyed by excavation. These, for the most part, were floors removed to dig underlying material. Abutting relationships and details of masonry construction and bonding were recorded systematically during the summer of 1973, at the conclusion of excavation.

The following architectural data were recorded:

Floors. Particularly in the case of those removed during excavation, we were interested in the relationship of the floor to the plaster on adjoining walls, in the material composition of the floor and in floor thickness. Notes were made of the general condition of the floor and of any alterations, such as potholes, storage cists or remodeling. Floor area (Appendix B) was determined (1) by direct measurement along each wall and computation, assuming a regular geometric shape for the unit, and (2) with the aid of a compensating polar planimeter for irregular areas, measured on the final site map (scale 1:40). Area is rounded to the nearest tenth square meter in this report.

Hearths. The most common floor feature encountered at Antelope House was the hearth. For the several removed during excavation, we recorded on floor maps the placement, size and shape of the hearth, as well as the material of which it was constructed. The bottom surfaces of these features were often broken and crumbling baked clay; archeomagnetic samples were taken if adequate baked clay was present.

Loom Anchors. Several sets of *in situ* loom anchors were recorded. The anchors consisted of a pliable withe loop placed in a pit about 4 cm in diameter. When the floor and the anchor associated with it were removed, the anchor was mapped and described; the anchor was retained as a field specimen. Most of the anchors found at Antelope House, however, remain in place on the floors of the kivas in which they were discovered.

Metate Bins. Metate bins were photographed and mapped. In only one case (Room 35) were any grinding slabs found *in situ* at Antelope House. Pollen samples and flotation samples of the vegetal fill were obtained.

Sub-floor Cists. Another common feature in rooms and in the North and South Plazas, subfloor cists typically consisted of a ceramic utility vessel buried in the floor, serving as a liner. In several cases, the lining vessel had been cracked or broken before being recycled as a cist liner. The pot, or the fragments thereof, was retrieved after mapping and photographing the feature in place. Rectangular slab-lined storage cists were also found. Pollen and flotation samples were obtained from these features to determine prehistoric use patterns.

Miscellaneous Floor Features. Other features were described in the notes, mapped and photographed. Flotation and pollen samples generally were retrieved from these features, if feasible.

Plaza Features. Many floor features, including hearths, loom anchors and sub-floor cists, were found in the more open, unroofed areas of the site—the South, Central and North plazas.

Axe grinding grooves occur on boulder talus in the South Plaza, as do pictographs which are quite distinct in style and motif from the decorations found on wall plaster. Features 1 and 2, the roofed pits of the Central Plaza, are not duplicated in the rooms. The remaining features occur on walls and remain in place today.

Walls. In recording masonry walls and features associated with walls, the unit of analysis was the wall segment forming the boundary of the room. The wall segment is all or part of a permanent construction with observable boundaries in all six dimensions (two sides, two ends, top and bottom) and a uniform style of construction. The need for this concept arises from the fact that a wall frequently was constructed to bound more than one room, so that its attributes cannot conveniently be described in terms of a given room. We also could demonstrate that some complete walls were constructed of several units obviously added at different times.

It is reasonable to assume that a given wall segment was constructed over a fairly short period of time, probably by the same person or group. We assumed, therefore, that it represented a completed project, the archeological result of the work of an individual mason or of a group of masons. Bonded corners do not constitute boundaries for the segments, since bonding implies contemporaneous construction of the walls meeting at a corner. There are forms of wall interrelationships intermediate between a "pure" abutment and a "pure" bond; these should carry no notion of contemporaneity. Such intermediate forms were not observed at Antelope House, although they were anticipated. We recorded the size, shape and position of each wall segment and its abutment relationship with wall segments above, below and to each side of it.

Wall Composition. In description and analysis which focus upon systematic, recurring stylistic variables and on their occurrence within the site, the techniques employed to select, shape, arrange, set and finish stones and other elements (logs, etc.) are critical. We are focusing upon the behavioral regularities of a mason or group of masons by contrasting minute differences in construction technique visible in the walls they built. The technique used to shape the stones comprising the wall was noted, with particular attention to the technique used on the visible surface of the stone and its *in situ* appearance. The type of chinking in the wall and its general frequency were noted, along with some indication of its regularity of occurrence in the wall. The number of stones exposed in the wall cross section was noted, as was the nature of a core, if present. Where it could be detected, the presence in wall material of recycled stone was noted; the "recycled" label was applied to a thickly sooted or plastered stone found in a wall in which the adjoining mortar and other stones exhibited no soot or plaster.

Plaster. We recorded in sequence the type of plaster, its color and its general condition. Any embellishments or decoration, such as designs, pictographs or other artwork, were recorded and photographed.

Pegs. These are wooden rods, typically 2 cm in diameter and 30 to 40 cm long, set into the wall masonry and projecting approximately 20 cm into the interior space of a room. Dimensions, species and position were determined for these features.

Apertures. Openings in the walls, either complete or fragmentary, were mapped. Recorded features include dimensions and shape, construction of sill, lintel and jamb(s), and outline of jamb. Depth (distance front to back) was recorded for niches, which did not extend completely through the wall.

Ceilings and Roofs. No intact ceilings were visible at Antelope House at the beginning of the project, although one was located during excavation. We anticipated finding partially collapsed roof remains and timbers, hopefuly in stratigraphic order, in the fill, but none were found; there are no roof details whatever to record. Where possible, diameter, type and orientation of beams were recorded from beam casts in walls. Species of closing material, identified by distinctive patterns of smoke deposition, were noted.

Observations

Complementing the data presented in this section are two appendices: Appendix B summarizes basic data on floor features and Appendix C presents, in numerical order, descriptive summaries of the identified rooms at the site.

Floors. Use surfaces within rooms were intentionally constructed of hardpacked clay and mud, typically about 3 cm to 5 cm thick. At the

time of construction, hearths, metate bins and other features (Appendix B) were incorporated into the rooms, although subsequent remodeling was sometimes detectable, as in the case of Room 25. Many of the floors, particularly those in the South Room Block, were placed atop as much as a meter of trash, which covered earlier floors. Surfaces in the South Plaza, Central Plaza and North Room Block were constructed in a manner identical to those within the rooms. Debris frequently was so compressed and compacted by foot traffic that it became incorporated into the floor. This reached an extreme in the hard-pack area of the North Room Block.

Hearths. Five hearths at Antelope House were circular in plan view, though often a square, slab-lined cist was contained within the circular clay rim. The occurrence of this hearth form correlates clearly with kivas. All circular hearths were located centrally in a room. Circular hearths in rectangular rooms lack this clay rim; the bare slabs were set in a circle and chinked with mud.

Thirty-nine rectangular slab hearths, located centrally within rooms, against room walls or outside rooms, were recorded. The hearths were built of upright sandstone slabs mortared in place, often with a floor of packed clay. Some hearths may be functionally unrelated to the rooms in which they were found. Lack of smoking on walls and the construction sequence suggests that some exterior hearths were enclosed by room walls as the pueblo expanded. Room 41 (3.2 m^2) is the smallest room with a definitely related hearth.

Cists. Slab cists are associated with Room 21, Floor 3; Room 29, Floor 3; and Room 75; all but that in Room 21 are associated with hearths. The cists in Rooms 29 and 75 contained corrugated vessels. Pollen counts support the hypothesis that these vessels and cists were involved in food preparation.

Corrugated jars, placed so that their mouths were level with the floor surface, were found in both interior and exterior floors. The embedded vessels apparently served as built-in storage receptacles; the packed clay on the floor is firmly packed around the vessel orifice, making it a permanent fixture. All vessels of this type had smoke-blackened exteriors and were frequently cracked or broken, suggesting that they were recycled cooking vessels. These were typically found empty or with minor amounts of fill, which apparently were similar to the surrounding fill. Rough sandstone slabs sometimes were set over the openings of the vessels to close the interiors; more elaborate lids were not found with these containers, although well–made, precisely shaped clay lids were recovered from fill. In Room 22, Floor 2, and in " Room" 38 were found embedded vessels filled with solid clay material; they apparently were filled during construction of later, closely spaced floors. Some vessels were found *in situ* in slab-lined cists level with the floor surface, suggesting that the vessel could be removed. Some sub-floor, slab-lined cists contained no vessels; these probably were used for more versatile storage of materials.

Embedded vessels are concentrated in the P II and P III stratigraphic units of the site and in the South Plaza. There are five embedded vessels around the large hearth (Provenience 1317) set in the lower plaza floor (Floor 130). A sixth embedded pot, found adjacent to Room 1, FS 2192, is within 2 m of this firepit and may be in functional association with it. Embedded pots occur in Floor 5, Room 29, and in Floor 2, Room 16, both of which are Early P III. No embedded vessels were found in the rooms or use surfaces associated with the Central Plaza.

As the pollen analysis by Vaughn Bryant (Chapter 25) indicates, embedded vessels typically contained large quantities of *Cleome* and *Zea mays* pollen. Since the surrounding floor surfaces also contained proportionately large quantities of these pollen types, we have inferred the regular use of these areas and storage units for food preparation. Embedded pots are early at Antelope House, suggesting that food preparation methods changed during the Middle P III and Late P III stages to a more flexible and versatile arrangement involving the use of portable cooking and storage vessels and wider use of the more flexible "pot and pit" method of food storage. This is consistent with the apparent use of more portable metates, as shown by the absence of fixed bins. This, in turn, correlates with the shift to a wider range of room sizes, indicating a more specialized function for a given room, particularly of those used for food storage.

Loom Anchors. These features did not exist at Antelope House until Late P III times. Sets of four anchors occur in Kivas A, 18, 23 and 42. Kiva 18 had two sets of loom anchors; the others each contained one set. All *in situ* loops were set

in depressions and did not protrude above the surface. All loom anchor sets lay parallel to the hearth/ventilator axis, roughly east-west.

Similar anchored loops occurred in Room 22, Floor 1; Room 36, Floor 2; and in the Central Plaza. A set of two loops was recovered from the Central Plaza and single anchors came from the two rooms. These loops were not set in depressions; whether or not they served as loom anchors is problematical. All occurrences date to Late P III. The occurrence in Room 36 is the only possible exception to the generalization that anchors were placed in open areas, since Floor 1, Room 22, was a small plaza. Not enough remained of Room 36 to determine its precise nature.

Metate Bins. Metate bins are rare at Antelope House; only 15 were found and two of that number are conjectural (Table 4). Only one metate was found *in situ* in a bin.

Three types of bins, defined solely by the form of the enclosure, were found at Antelope House. Most elaborate is a form consisting of a collecting basin for the ground meal, with an adjacent basin for an inclined metate. A less elaborate type held the metate nearly flat and lacked a formal collecting basin; the depression in which the metate was set is bounded by upright sandstone slabs. The third type is an unlined depression, which could have held a metate, although there is no certain evidence for this.

Room 30 contained six metate bins, arranged in two sets of three; one set was found in the west half of the room, the other in the east half, indicating use of this room for grinding maize and other grains. There would have been little room for other activities. This specialization is unique at Antelope House and there is no description of a similar room in Canyon de Chelly with which to compare it. There also are more apertures in the walls of Room 30 than in those of any other room in the site; all give access to the grinding area. Another unique feature is the large number of conspicuous white pictographs which adorn the room's walls.

The distribution of metate bin types suggests that fixed bins with collecting basins were later replaced by simple basins, a trend opposite to that reported elsewhere in the Anasazi region (Woodbury 1954: 59). It appears that at Antelope House the elaborate bin, presumably with a slab metate, came into use in P III times, but that it was abandoned by AD 1200 (Late P III) in favor of a more portable, simpler troughed form. The known metate bins are heavily concentrated in the South Room Block (11 of 15 occurrences), an area which contains all of the fixed bins with collecting basins. The only occurrence in the Central Room Block is also the only occurrence within a kiva.

Masonry Construction. The typical wall at Antelope House is rather roughly coursed masonry construction about 20 cm thick. Stones are laid in generous quantities of mortar, with variable amounts of chinking between the stones. The wall is often one course wide, Rohn's (1971) "simple wall." Compound walls are the second most common type. In general, the masonry resembles that recorded in the Kayenta region (Dean 1969; Ambler *et al.* 1964).

Wall Segments 44 (Central Plaza), 74 (Kiva A), 113 (Kiva C), 94 (Kiva D) and 13 (Kiva 47) are massive stone constructions. These walls contained considerable numbers of stones which

Table 4. Occurrence of metate bins.

Rm/Floor	*No.*	*Type*	*Period*	*Remarks*
1/fl. 4	1	inclined slab/collecting basin	PII	
5/fl. 1	1	flat	LPIII	
21/none	3	flat	MPIII	below fl. 2; not associated w/floor
28/fl. 1	1	metate-shaped depression	LPIII	conjectural
29/fl. 6	1	flat	PII	
30/fl. 2	6	inclined slab/collecting basin	MPIII	
35/fl. 2	1	flat	EPIII*	only occurrence with a metate
42/fl. 1	1	metate-shaped depression	LPIII	conjectural
	15			

*not firmly dated

appear in neither face of the wall. There is no "Chaco style" rubble core construction at Antelope House like that at White House or the Standing Rock Ruin.

The rocks in the walls of Antelope House display three types of face finish: edge chipped, broken and pecked/ground. "Edge chipped" refers to elongated, horizontally placed slabs, often percussion-trimmed around all edges; these are similar to those described by Earl Morris (1939: 34). The length of the slab is frequently two or three times the width. "Broken" refers to wall rock which presents a reasonably smooth, but irregular surface, the result of breaking the stone with one blow and no subsequent modification. The stones are thicker and more rectangular than are edge chipped slabs. Pecked and ground stones have the same general shape as broken face stones, but they have been pecked with a hammerstone and partially ground to provide a much smoother surface. Stones of this type tend to be somewhat more regular in size than those of the other types.

The use of edge chipped stone slabs, the most common wall rock in the earliest construction in the South Room Block (WS 75; see Fig. 17), declines through time and is replaced primarily by the use of broken face stones in later periods. Pecked and ground stone in walls is rare and occurs fairly late in the sequence; it is found only in WS 70, 74 and 118, all of which are in the southern portion of the site.

Walls at Antelope House are typically 20 to 25 cm thick, even in Rooms 3 and 10, which were four stories high. The wall of the Central Plaza is 30 to 70 cm thick. WS 70, bounding Room 23 to the east and north, is 35 to 45 cm thick and is the most "Chaco-like" of any wall at the site (Fig. 18). WS 76, the upper section of Room 1, also is 35 to 45 cm thick. Kiva walls, particularly near benches, are also massive and thick. The thicker walls are created by the use of more massive wall rocks, with occasional interior stones carefully set in a mortar bed; there is no true rubble core masonry at the site.

Some walls present a regular, reasonably smooth appearance on one side and a rough, irregular appearance on the other, with no attempt to compact mortar or to fill voids. This situation is indicative of a wall built as a facing for an excavated pit, a so-called "one-sided wall." It occurs notably in WS 23, 24, 26, 35, 45 and 47.

Chinking, the insertion of smaller rocks into mortar beds, is present in most wall segments. There seems to be no correlation between chinking and other attributes of the masonry considered here. With the possible exception of WS 70, there is no suggestion that chinking was intended to serve a decorative function. This is not too surprising, since we know that both interior and exterior walls are plastered.

Several P III jacal walls occur throughout the site and throughout the sequence, including one of the last constructed at the site (Room 41). Little is known of construction details, since the only evidence for these walls consists of post holes outlining the structure; they do not appear to differ from earlier construction. Rooms 41, 82 and 87 each contained three jacal walls and a fourth wall of pre-existing masonry. Room 74 contained four jacal walls, while Room 28 was subdivided by two poorly preserved jacal constructions. The nature of presumed walls in Rooms 83, 84 and 88 is unknown. Where stubs remain we can state that cottonwood posts were commonly placed as the main uprights.

Earlier walls occasionally were incorporated into later construction. WS 83, an earlier jacal fragment, is surrounded by the later WS 17 (Rooms 51 and 49). Wall Segment 38 overlies an earlier unnumbered jacal. Wall Segment 75 was utilized as a foundation for WS 76 (Fig. 19), as was WS 61 for WS 89. In Structure 8, an earlier jacal is the base for the masonry wall of the unit.

WS 47 (Room 91) consists solely of a line of upright basal slabs (Steen 1942). Upright basal slabs occasionally are incorporated into other walls, as in WS 52, Room 89 (Fig. 20), and WS 81, Rooms 2/9.

Six wall segments at the site incorporate adobe turtleback blocks or recycled jacal clods in their construction. Two of these, WS 106 (Structure 73) and WS 111 (Structure 68), date to Pueblo I. The remaining four occur in the north half of the site and are relatively late. They are WS 9 (Room 20), WS 36 (Room 37), WS 39 (Room 44/45) and WS 45 (Kiva 42). The recycling of these adobe jacal clods in late P III walls suggests an expedient not used in earlier construction.

Recycled rock is present in 31 walls, but none were built primarily of older building stones, although WS 9 contains many impressed clods. Walls were torn down from time to time, the most clearcut example being the walls of Rooms

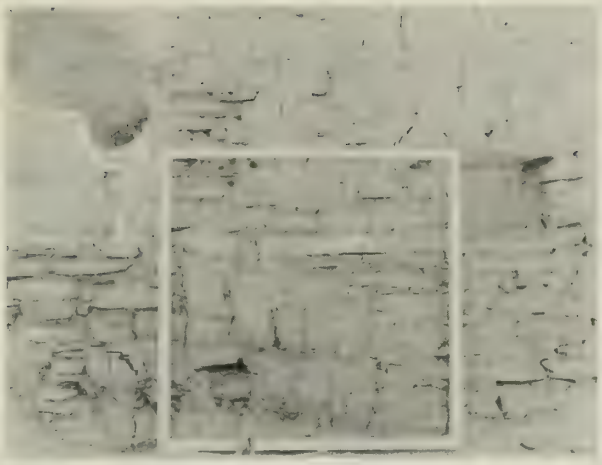


Figure 17. Wall Segment 75, southwest of Room 30. Frame encloses 1m².

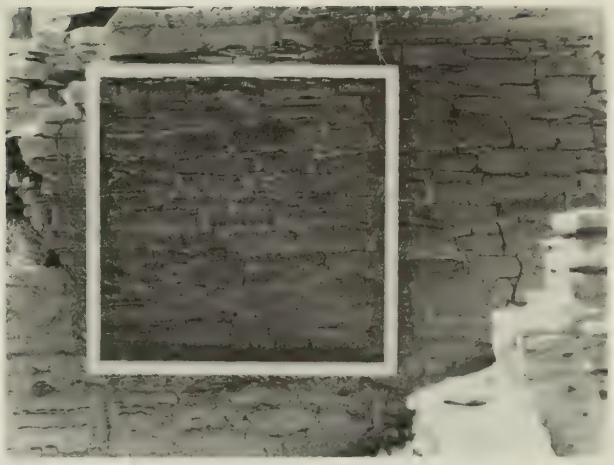


Figure 18. Wall Segment 70, the north wall of Room 23 and west wall of Kiva A enclosure, is the closest approach to Chaco style masonry at Antelope House. Note the regular chinking and pecked and ground blocks.

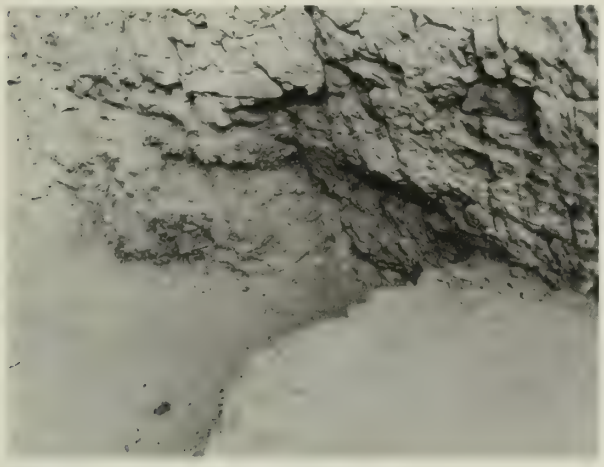


Figure 19. Wall Segment 75 (lower right) served as foundation for Wall Segment 76.



Figure 20. Wall Segment 52, the wall surrounding Room 89. Upright slabs are unusual.

75, 76 and 77 (WS 84–88). These walls were very low, with no evidence of collapse; the upper South Plaza floor was placed over the former rooms. Walls in the Central Room Block, which was built last, show more than double the use of recycled stone evident in either the South or North Room Blocks.

Table 5 summarizes construction details for each of the identified wall segments (WS) at Antelope House.

Plaster. Multiple coats of plaster are associated with kivas, with as many as 17 coats occurring in one (Kiva 47). Other kivas contained three to 14 coats. The number of plaster coats per kiva agrees roughly with the kiva's length of use, as described in Chapter 6. The greatest number of coats in a secular room, however, was five. Multiple coats of plaster frequently are alternating layers of white and tan. The so-called "tan" plaster is the readily available canyon-bottom mud; the white plaster is a kaolin-like material found only in the Chinle formation on the plateau or at the mouth of the canyon, according to Chauncey Neboyia (1972: personal communication). This white material is apparently used for pictograph art at Antelope House and at other sites in the canyon. Most coats are heavily smoked.

The exteriors of rooms also were coated with plaster. The typical exterior coat is thick (approximately 1 cm), has a characteristic rough appearance and is often finger impressed. This plaster type is also found on interior surfaces in

Table 5. Summary of construction details for identified wall segments.

(Dimensions are in meters. Abbreviations used are: BRO—broken face; JAC—jacal; IND—indeterminate; SCA—edge chipped; B&S or S&B—broken face and edge chipped, dominant type listed first; P&G—pecked and ground; PBG—pecked and ground and broken; + = presence; − = absence.)

Wall Segment Number	*Face Finish*	*Number of Stones in Cross Section*	*Extent of Chinking*	*Presence and No. of Upright Slabs*		*Basal Slabs are Elevated*	*Presence of Reused Rock*	*Presence of Plaster*	*Average Height*	*Length*	*Average Thickness*
1	BRO	1.0	rare	+	7	+	−	+	1.50	3.05	.28
2	BRO	1.3	occasional	−	−	−	+	+	.10	7.37	.25
3	BRO	1.8	occasional	+	6	+	+	+	1.70	7.75	.41
4	BRO	1.0	absent	−	−	−	+	−	.15	1.47	.21
5	BRO	1.0	absent	−	−	−	+	−	.10	1.13	.17
6	BRO	2.1	absent	−	−	−	+	−	.10	.53	.31
7	BRO	1.0	absent	−	−	−	−	+	.10	.62	.15
8	JAC	NA	absent	−	−	−	−	+	.10	4.45	.10
9	BRO	.1	absent	−	−	−	−	+	1.10	2.10	.23
10	BRO	1.2	absent	−	−	−	−	−	indet.	2.00	.30
11	IND	1.0	absent	−	−	−	−	−	.05	.20	.25
12	BRO	1.0	occasional	+	1	−	−	+	1.10	2.05	.20
13	BRO	2.0	rare	−	−	−	−	+	2.10	13.60	.34
14	S&B	1.0	common	−	−	−	−	+		2.80	.25
15	BRO	1.0	rare	−	−	−	−	+	.10	1.20	.18
16	BRO	1.0	absent	−	−	−	−	−	.05	1.87	.27
17	B&S	1.0	occasional	−	−	−	−	−		1.97	.21
18	BRO	1.0	rare	−	−	−	−	+		1.90	.20
19	BRO	1.3	common	−	−	−	−	+		4.70	.25
20	BRO	1.0	occasional	−	−	−	−	+		2.80	.25
21	BRO	1.0	absent	−	−	−	+	+	1.16	.30	.25
22	S&B	1.0	common	−	−	−	+	+	3.25	4.24	.30
23	BRO	1.0	occasional	−	−	−	−	−	.75	3.37	.17
24	BRO	1.0	absent	−	−	−	−	+	.85	8.16	.18
25	BRO	1.0	occasional	−	−	−	+	+	1.25	3.13	.23
26	BRO	1.0	occasional	−	−	−	−	+	1.00	22.45	.28
28	BRO	1.0	absent	−	−	−	−	+	1.00	1.76	.19
29	BRO	1.3	common	+	1		−	+	1.10	2.68	.25
31	BRO	1.0	absent	−	−	−	−	−	.30	.46	.40
32	BRO	1.0	occasional	−	−	−	−	−	.30	.52	.39
33	BRO	1.0	rare	−	−	−	−	+	.90	2.07	.23
35	BRO	1.0	occasional	+	1		+	+	.46	3.90	.21
36	BRO	1.0	absent	+	4	1	+	+	.31	2.40	.29
37	SCA	2.2	absent	−	−	−	−	+	.12	.53	.38
38	SCA	1.0	absent	−	−	−	−	+	.22	1.00	.35
39	BRO	1.0	absent	−	−	−	+	+	.63	1.40	.23
40	BRO	1.0	rare	−	−	−	−	+	.82	1.19	.29
41	BRO	1.0	absent	+	1		−	+	.40	1.27	.15
42	BRO	1.0	absent	+	3	1	−	−	.35	1.47	.08
43	BRO	1.3	common	+	1	2	+	−	.75	4.00	.20
45	BRO	1.0	rare	+	1	−	+	−	1.20	7.80	.27
46	BRO	2.0	rare	−	−	−	−	−	1.15	5.30	.25
47	BRO	1.0	absent	+	8	1	+	−	.25	3.24	.09
48	BRO	1.8	occasional	+	1	−	+	−	1.05	2.62	.22
49	BRO	1.9	common	−	−	−	+	+	1.08	1.60	.22
51	BRO	1.0	absent	−	−	−	+	−	1.20	.47	.28
52	BRO	2.0	common	−	−	2	+	−	1.55	10.57	.26
53	BRO	1.3	rare	−	−	−	+	−	.30		
54	BRO	1.0	rare	+	1	1	−	−	.15	3.64	.21
55	BRO	1.3	rare	−	−	−	−	+	.10	2.98	.22
56	BRO	1.0	absent	−	−	−	−	−	1.35	1.81	.26
57	BRO	1.0	absent	−	−	−	+	−	1.40	1.32	.22

(Continued)

Table 5. Summary of construction details for identified wall segments—Continued

Wall Segment Number	Face Finish	Number of Stones in Cross Section	Extent of Chinking	Presence and No. of Upright Slabs		Basal Slabs are Elevated	Presence of Reused Rock	Presence of Plaster	Average Height	Length	Average Thickness
58	B&S	1.2	occasional	–	–	–	–	+	.38	7.40	.27
59	BRO	2.0	absent	–	–	–	+	–	.36	1.57	.24
60	BRO	1.8	absent	–	–	–	+	+	.44	2.63	.27
61	SCA	1.0	common	–	–	–	–	+	.30	9.20	.25
62	BRO	2.0	occasional	–	–	–	–	–	.40		
63	BRO	1.2	absent	–	–	–	–	+	1.05	1.93	.22
64	BRO	1.2	occasional	+	1	1	–	+	1.30	5.16	.25
65	BRO	2.0	occasional	–	–	–	–	+	.80	1.38	.24
66	BRO	1.0	absent	–	–	–	–	–	.15	.69	.17
67	BRO	2.0	occasional	–	–	–	–	–	1.00	3.17	.28
68	BRO	1.0	rare	–	–	–	+	–	.63	1.68	.25
69	BRO	1.0	rare	+	1	–	–	–	.58	1.45	.19
70	P&G	3.0	common	–	–	–	–	–	2.10	10.67	.48
71	PGB	1.3	occasional	+	1	1	+	–	1.10	11.20	.40
72	SCA	1.0	occasional	–	–	–	–	+	1.40	6.35	.30
73	SCA	1.0	—	–	–	–	–	+	.65	3.38	.25
74	P&G	2.0	occasional	–	–	–	–	+	1.65	10.80	.75
75	SCA	1.3	common	–	–	–	–	+	2.85	40.70	.25
76	BRO	1.5	common	–	–	–	–	+	2.88	10.90	.45
77	SCA	1.0	—	–	–	–	–	+	3.00	2.20	.20
78	BRO	1.0	—	–	–	–	–	–	2.35	2.25	.18
79	SCA	1.0	—	–	–	–	–	+	2.00	2.26	.18
80	SCA	1.3	common	–	–	–	–	+	2.15	4.60	.22
81	BRO	1.7	occasional	+	1	1	+	+	2.50	6.04	.28
82	S&B	1.2	occasional	+	1	1	–	+	1.40	3.30	.26
83	JAC		—	–	–	–	–	–	.05	.90	.12
84	BRO	2.0	common	–	–	–	–	–	.35	2.33	.25
85	BRO	2.0	common	–	–	–	–	+	.35	2.98	.24
86	BRO	1.0	absent	–	–	–	–	–	.15	.42	.22
87	BRO	1.3	occasional	–	–	–	–	+	.42	9.40	.28
88	BRO	2.0	occasional	–	–	–	–	+	.18	2.18	.22
89	BRO	1.1	occasional	–	–	–	+	+	5.00	12.01	.28
90	B&S	1.3	common	–	–	–	–	–	.35	2.70	.21
91	BRO	1.0	occasional	+	2	1	–	–	.29	3.08	.20
92	BRO	1.0	occasional	–	–	–	–	+	.20	1.75	.17
93	BRO	1.0	rare	–	–	–	–	–	.40	1.27	.18
94	BRO	1.3	occasional	–	–	–	–	+	.69	12.52	.34
95	JAC		—	–	–	–	–	–	.05	1.08	.08
96	BRO	1.0	absent	–	–	–	–	–	.87	.93	.40
97	BRO	1.0	absent	–	–	–	+	+	.30	.60	.24
98	BRO	1.0	absent	–	–	–	+	–	1.03	.78	.23
99	BRO	1.0	absent	–	–	–	+	–	1.01	.68	.23
100	BRO	1.0	absent	–	–	–	–	–	.30	.44	.22
101	BRO	1.0	occasional	–	–	–	+	–	.94	.66	.33
102	BRO	1.0	occasional	–	–	–	+	–	1.32	.46	.30
103	S&B	1.0	common	–	–	–	–	–	0.00	9.40	.27
104	BRO	1.0	common	+	8		–	–	.96	4.10	.11
105	BRO	1.0	common	+	11	1	–	–	2.03	5.95	.25
106	MOL	1.0	absent	–	–	–	–	+	1.00	3.15	.12
107	JAC								.90	7.37	.10
108	BRO	1.0	absent	+	5	1	–	–	.87	2.35	.07
109	BRO	1.0	—	–	–	–	–	+	.05	.75	.26
110		1.0	—	–	–				1.24		
111	B&M	1.0	occasional	+	7	1	–	–	1.10	3.02	.10

(Continued)

Table 5. Summary of construction details for identified wall segments–Continued

Wall Segment Number	Face Finish	Number of Stones in Cross Section	Extent of Chinking	Presence and No. of Upright Slabs	Basal Slabs are Elevated	Presence of Reused Rock	Presence of Plaster	Average Height	Length	Average Thickness
113	BRO	2.0	common	– –	–	–	+	.88	11.40	
114	BRO	2.5	rare	– –	–	–	+	.79	1.35	.55
115	BRO	1.0	absent	– –	–	–	+	.38	11.30	
116	BRO	1.0	—	– –	–	–	–	.40		
117	BRO	1.3	occasional	– –	–	–	+	4.70	3.58	.28
118	P&G	1.0	common	– –	–	–	–	.91	7.10	.29

many P II and Early P III units; later units tend to have a thin finished coat over a thick base coat. Thin finished coats, either white or tan, generally are found in larger rooms (Fig. 21). Rooms 45, 50, 32 and 16 are exceptions, but the thin coats recorded in Rooms 16 and 32 were applied before a larger original room was subdivided. Disregarding this intermediate case, there are nine rooms in the southern portion of the site with thin finished plaster coats, as opposed to two in the North Room Block, so that it seems that finished plaster coats are highly correlated with multiple story units.

The use of white plaster is also associated with the south portion of the site. While in part this is simply a function of the greater amount of masonry in the south, the identical pattern is present in the distribution of pictographs, with most rock art and rock art motifs in white occurring in the vicinity of the South Room Block, the South Plaza and even farther south. The only examples of pictographs on walls occur in the South Room Block in Rooms 10 and 30 (Fig. 21).

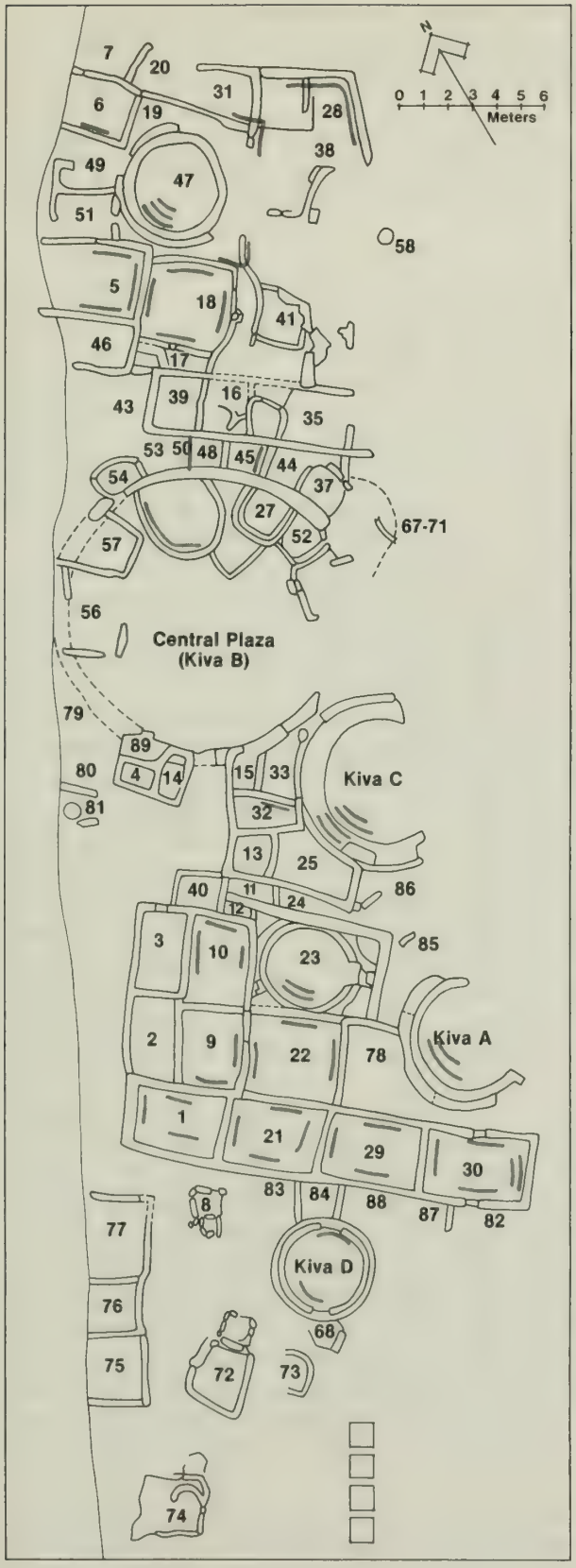
Wall Pegs and Minor Features. Wall pegs, projecting wood rods approximately 3 cm in diameter, were recorded in the east wall of Room 10, third story; Room 3, north wall, third story; and Room 2, north wall, second story. The first and third cases were paired with empty sockets, which must have held similar pegs, so as to form a sort of rack. All wall pegs are associated with either WS 89 or WS 117, which were constructed simultaneously during Middle P III times.

Two instances of toeholds, indentations in masonry walls shaped precisely like the numerous chipped holds found in the sandstone throughout the canyon, were recorded. One is located in WS 33 on the interior of Room 39. The other occurrence is a set of three in WS 34 on the interior of Room 35.

Apertures. Forty-three apertures were recorded in the surviving walls at Antelope House. We have categorized these as doors, T-doors, windows, niches, sipapu niches and ventilators. The last two are associated exclusively with kivas; indeed, the presence of a ventilator and hearth defines a kiva. Since the majority of the architecture at Antelope House is found in the South Room Block, most of the openings are also located there (Table 6).

Niches, seven of which were recorded, provide an exception: four occur in the North Room Block and three are found in the Central Room Block. A niche is defined as a cavity found in only one side of a wall. A typical niche is formed by simply omitting masonry to produce the proper cavity; it may have a sill and lintel, if these terms may be used, of either a sandstone slab or masonry. Construction of some niches could not be determined, because of the smooth plaster covering the niche and the surrounding masonry.

Ventilators feature a vertical shaft and a horizontal above-floor tunnel, as do ventilators reported elsewhere in the Southwest. A sipapu niche is merely a niche found in the kiva wall,



usually below the bench and in line with the fireplace deflector-ventilator axis. Only two Early P III kivas, Kiva C and Kiva 47, Jack sipapu niches.

Windows and doors are separated intuitively on the basis of their size, although it is possible to enter and leave a space through some of the larger windows. Construction of lintels varies predictably between doors and windows; doors have pole lintels and windows have masonry lintels or slabs. The lone exception is the indeterminate aperture connecting Rooms 10 and 23, which seems to be a window but which has a pole lintel. All windows have plain jambs, with sills formed of either masonry or sandstone slabs.

Two T-doors were recorded: one each in the North and South Room Blocks. Both had been blocked by the time the site was fully developed and both were built during the Early P III period. Of the 17 rectangular doors at Antelope House, 14 occur in the South Room Block. The sills in these doors are made either of masonry or of a sandstone slab. All surviving lintels are formed by a series of poles. The typical jamb is of masonry, with a plain rectangular outline. Adobe moldings, formed to receive a sandstone slab door, were recorded for the door in Room 26, Central Room Block, for the first story door in Room 3, which connects the room with the Central Plaza Annex, and for the third story doorway connecting Rooms 3 and 10, although this molding had collapsed by 1970. This feature is found in both habitation and storage rooms and may have been more common at Antelope House than the remaining evidence indicates.

Roof Construction. Evidence for roofing techniques and materials used in roof construction was uncommon at Antelope House, consisting of plaster outlines on walls and the cliff face, beam sockets in some walls with high standing masonry and fragments of clay roof clods and closing materials in secondary refuse within rooms. Most of this evidence is concentrated in the South Room Block and pertains to it alone.

Figure 21. Occurrence of thin finished plaster coats and and pictographs, Middle and Late Pueblo III.

Table 6. Wall openings (niches, doors, windows and ventilators).
(Abbreviations: CPA = Central Plaza Annex; SP = South Plaza; CP = Central Plaza; PO = Pole; SL = Slab; MA = Masonry; UN = Unknown. All measurements in centimeters.)

	Functional Type	*Wall Segment Number*	*Wall of Room*		*Connecting To*	*Width*	*Height*	*Depth*	*Lintel Type*	*Sill Type*	*Open or Blocked*	*Blocking WS #*
South Plaza	Ventilator	94	E	D		38	52	115	PO	SL	0	
	Sipapu niche	94	N	D		17	17	25	UN	UN	0	
South Room Block	Door	117	E	3	10	52	77	26	PO	SL	0	
	Door	117	E	3	10	56	80	30	PO	SL	0	
	Door	80	E	29	30	0	75	23	UN	UN	0	
	Door	82	E	9	22	0	48	25	UN	MA	0	
	Door	89	N	3	CPA	44	100	25	UN	SL	0	
	Door	75	S	1	SP	60	40	0	UN	SL	B	76
	Door	75	S	1	SP	60	30	0	UN	SL	B	97
	Door	75	N	21	22	78	103	0	PO	MA	B	98
	Door	75	N	29	78	68	101	0	PO	MA	B	99
	Door	75	N	30	78	66	94	33	UN	MA	B	101
	Door	75	S	30	82	50	70	24	UN	UN	0	
South	Door	76	S	1	SP	45	70	44	UN	UN	0	
Room	Door	73	E	22	78	65	30	23	PO	UN	0	
Block	Door	103	E	10	23	53	94	30	UN	MA	0	
	T-door	76	N	1	9	52	56	0	UN	SL	B	102
	Window	89	E	10	23	65	65	22	PO	MA	0	
	Window	75	N	29	78	44	30	22	UN	UN	B	100
	Window	75	S	29	87	44	47	25	SL	SL	0	
	Window	75	S	30	82	32	29	22	SL	SL	0	
	Window	75	S	30	82	29	20	28	SL	MA	0	
	Window	75	S	30	82	33	30	25	SL	SL	0	
	Ventilator	71	E	23		29	32	60		SL	0	
	Sipapu niche	71	W	23		20	33	20	UN	UN	0	
		75	N	1	2	60	75	0	UN	UN	B	
Central	Door	69	W	40	CPA	40	0	20	UN	SL	0	
Room	Door	48	W	26	CP	40	30	20	UN	SL	0	
Block	Ventilator	45	E	42		23	30	0	UN	SL	0	
	Niche	45	N	42		31	30	32	UN	UN	0	
	Niche	45	E	42		13	30	39	UN	UN	0	
	Niche	46	W	27		12	11	11	SL	SL	0	
	Sipapu niche	45	W	42		14	23	40	UN	UN	0	
North	Door	19	N	5	51	0	93	27	—	—	0	
Room	T-door	20	E	5	18	65	87	25	MA	MA	B	21
Block	Window	22	S	5	46	34	52	23	UN	UN	0	
	Window	33	E	39	16	27	32	22	SL	SL	0	
	Ventilator	13	E	47		25	42	200	MA	MA	0	
	Ventilator	24	E	18		32	42	80	SH	SL	0	
North	Niche	25	S	18		15	12	19	SL	SL	0	
Room	Niche	28	W	18		11	11	14	UN	UN	0	
Block	Niche	26	N	39		2	22	22	MA	MA	0	
	Niche	1	E	31		7	15	15	SL	MA	0	
	Sipapu niche	28	W	18		11	13	7	UN	UN	0	
	Unknown	12	E	6		0	50	25	—	—	0	

The only complete roof found at the site covered Structure 8, a P II and Early P III unit in the South Plaza. Several secondary roof beams, running north-south, are supported by a single primary roof beam in the middle of the room; beams are cottonwood logs. This roof seems typical of the larger roofs once present at the site, although it is much smaller.

The former presence of roofs is shown by a series of empty beam sockets in 11 roof levels in the South Room Block and in one in the North Room Block (Room 5, first story). The South Room Block sample comes from Room 1, first story; Room 2, second story; Room 2, third story; Room 3, first story; Room 3, second story; Room 10, first story; Room 10, second story; Room 10, third story; Room 21, second story; Room 29, second story; and Room 30, first story.

This sample indicates that the typical roof was constructed by placing a series of four to eight beams parallel to the long axis of the room as the main roof support. Succeeding secondary beams and closing material, if placed, were not socketed in the walls and left no permanent record. Closing materials recovered from secondary refuse include corn stalks and juniper bark, with juniper bark most common. Other species undoubtedly were used, but were not recognized in our analyses. Judging from the broken roof clods recovered from the excavation and measured in the field, clay was packed over the closing material to a depth of approximately 10 to 12 cm. The finished roofs were 20 to 25 cm thick, measured from the top of the primary beam supporting sockets to the top of the packed clay of the roof, a position indicated on some walls by a jagged, irregular line of clay plaster.

In three instances, all in four-story rooms, beams were placed across the short axis of the room to provide additional support for the overlying beams spanning the long dimension of the room. This occurred in the first and second stories of Room 3 and in the first story of Room 10.

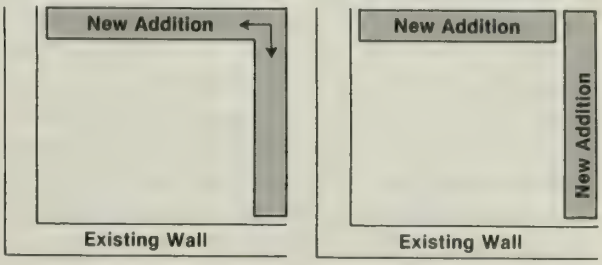
Beams, as determined by the casts remaining in the enclosing mud and the observed roof sockets, varied from 6.5 cm to 12 cm in diameter. Beams frequently were doubled and placed tip to butt in the same roof socket to provide greater support for the roof.

Features 1 and 2 in the Central Plaza yielded the largest stock of roof beams from the site; the context in which they were found (roofed subterranean cavities) makes it obvious that they were recycled. The four beams of Douglas fir from Feature 1 and one example of Douglas fir from Feature 2 are the only instances of this species used in roof construction at Antelope House. Oak (*Quercus* sp.) and ponderosa pine (*Pinus ponderosa*) were also associated with these features, demonstrating that all large arboreal species growing within easy walking distance of Antelope House, with the exception of pinyon, were used for roof beams. It is tempting to speculate that the Douglas fir beams recovered from Features 1 and 2 originally were used in kivas, a common pattern in other northeastern Arizona sites (J. Dean 1970: personal communication; Robinson 1967), but this cannot be tested with available data.

Log beams used for purposes other than roof construction were found. A set of paired logs set within the north wall of Room 10 jutted into the open space above Kiva 23 and may have provided support for a balcony on the east exterior of Room 10. Two cottonwood beams set in the north wall of Room 29 projected into Room 78; it is unlikely that these are associated with a roof in Room 78, since they would indicate a roof level bisecting the doorway between Room 29 and Room 78. They probably were projecting poles, designed for support or suspension.

Corner Abutment. Bonded corners are common at Antelope House. They characterize the exterior walls of the initial units of both room blocks and the exterior walls of additions to the South Room Blocks. Occasionally, primarily in the North Room Block, abutted corners were used when adding a room. The distinctions between the types are illustrated in Figure 22. In adding Rooms 5, 6, 40, 46, 51 and 75, the builders chose free–standing abutted corners, rather than bonded corners, in a situation where there existed no previous structural reason for doing so.

Figure 22. Diagrams of bonded corner (left) and abutted corner.



Room Size. Room area is assumed to be a functional attribute of the room's usage. This measure can be related to the presence or absence of hearths, bins, embedded pots and other floor features and to the treatment given the various walls of the rooms throughout the site. Headspace, an equally important measure in determining room function, is essentially unavailable for study. Even for those few rooms where evidence of the roof line remains it is not always clear which floor or floors relate to a given roof line, since several roof lines have been obliterated by replastering or by remodeling of the room space.

The area of rooms at Antelope House ranged from 0.3 m^2 (Room 1) to 16.9 m^2 (Room 23). Individual areas are given in Appendix C. Median room size decreased through time (Fig. 23), from 7.6 m^2 in Early P III to 5.9 m^2 in Middle P III to a low of 3.2 m^2 in Late P III. By Late P III times, two clusters of room size, at 2.5 m^2 and 8.0 m^2, developed from the less complex Early P III pattern, suggesting greater specialization in room function through time.

Plaza Features. Many architectural features characteristic of the rooms are duplicated in the unroofed spaces surrounding the room blocks—the South Plaza, the Tower Corridor, the Central Plaza Annex, the Central Plaza, "Room" 43 and "Room" 38. Room 22 by Late P III times had become a small plaza area.

Features found in both rooms and plazas at Antelope House include hearths, embedded ceramic vessels, prepared floors, loom anchors, and rock and wall pictographs. Features found only in rooms include wall pegs, metate bins, thin plaster coats and incised designs in wall plaster. Features found only in open areas are the trough-like units in the South Plaza and the apparently isolated upright posts and roofed pits in the Central Plaza ramadas.

This distribution suggests that cooking and meal preparation (hearths, embedded ceramic vessels) occurred in both plazas and rooms, prompting the hypothesis that seasonal changes of activity location occurred. Grinding of corn and other food preparation (metates) is indicated as an interior activity, as is some storage (wall pegs). The features found only in the open areas unfortunately are not items whose function is readily apparent. Since we know from abundant archeological evidence that turkeys were com-

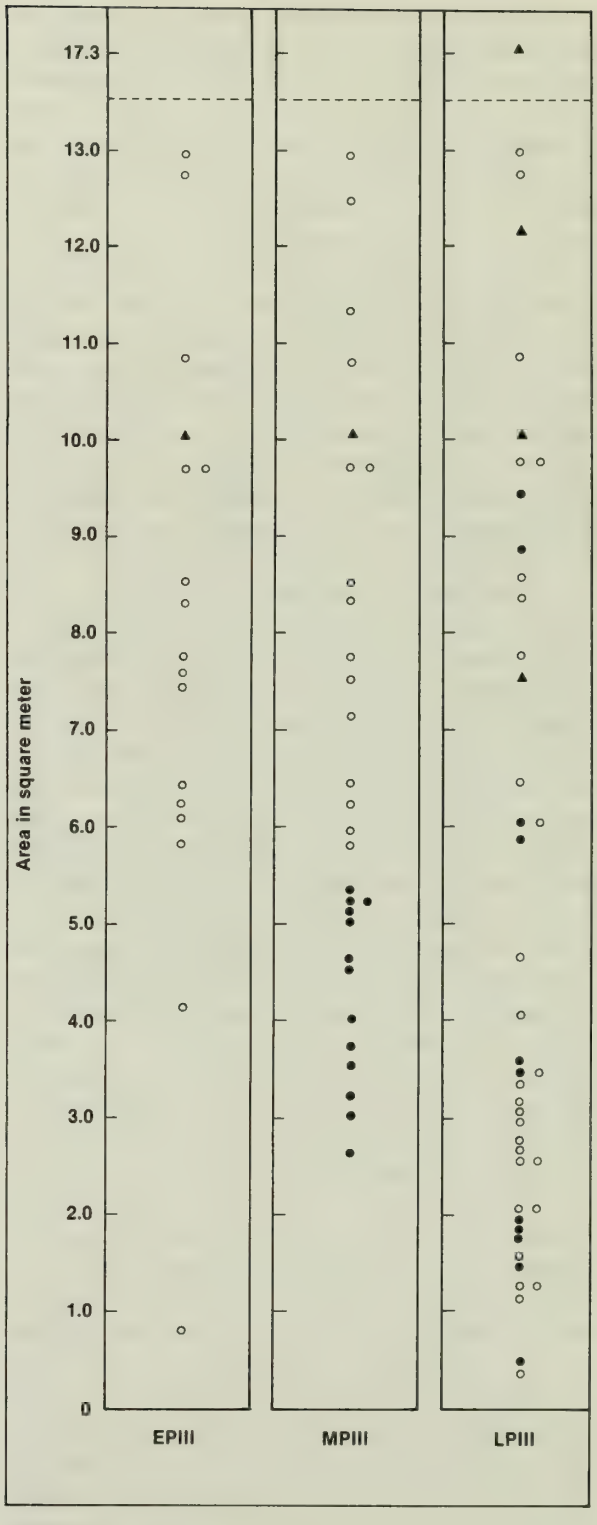


Figure 23. Distribution of room sizes, by period.

mon in the South Plaza, we may hypothesize that the open "troughs" found there may relate to the upkeep of the flock. The roofed pits of the Central Plaza are hypothesized to be ceremonial.

Kivas. The seven excavated kivas, those rooms with ventilation systems featuring an L-shaped vent shaft, deflector and fireplace, show distinct chronological and spatial patterns. Those structures recognized initially as kivas were given letter designations; those not so readily identified as kivas were assigned room numbers. Kiva D is in the South Plaza, Kivas A and 23 in the South Room Block, Kiva 42 in the Central Room Block and Kivas 18 and 47 in the North Room Block. Kivas 42, 18 and 47 form a cluster in the northern portion of the site; A, C, D and 23 form a southern cluster. The three northern kivas are placed to the rear (toward the cliff) of the room block, in contrast to the more streamward location of the southern kivas.

In addition to ventilator systems, all kivas at Antelope House contained rock slab ventilators and had smoothly plastered walls.

Several unique features also were noted: only Kiva 18 is rectangular; of the circular kivas, only Kiva 42 lacks a bench; only Kiva 23 contained anything similar to the "southern recess" of the Mesa Verde area; Kivas C and 23 retained evidence for upright log posts in their walls, features not noted elsewhere in the site; Kiva A contained small horizontal wooden pegs in the wall, suggesting a four-way division of the wall area, and Kiva 42 contained an uncommon number of wall cists. The ventilator in Kiva C has eroded away and its former existence is only a reasonable inference.

The northern kivas have no pilasters, while each of the southern kivas contain two, or can be demonstrated to have had pilasters in the past (Kiva A). Partially destroyed Kivas A and C retain pilasters in locations consistent with two-pilaster arrangements. The standard arrangement at Antelope House and at other kivas in the region (de Harport 1959; Steen 1966) finds a line connecting two pilasters forming an approximate right angle to the ventilator-sipapu axis.

Hearths in all but two of the latest units (18 and 23) were rectangular and slab-lined, essentially identical to those elsewhere in the site. Kivas 18 and 23 contained rectangular hearths covered with a circular adobe collar, imparting a round appearance to the hearth. These two kivas also were the only units containing subfloor cists. Archeomagnetic dates from the baked clay of these collars indicate that Kivas 18 and 23 are contemporaneous with one another.

Sets of loom anchors were found in all kivas dated to the Late P III period; none of the earlier kivas (C, D and 47) contained these features.

Sipapu niches, which are set in the wall of the kiva bench in the plane of the ventilator axis, occurred in Kivas A, D, 23, 42 and 18, but not in contemporaneous and relatively early Kivas 47 and C.

Comparative Domestic Architecture. While there is great stylistic variability in the architecture of the Canyon de Chelly region, with the Mummy Cave Tower cited as "Mesa Verde" (Morris 1941) and the lower portion of White House as "Chaco," most sites, including Antelope House, closely resemble Pueblo III Kayenta architecture.

Similarities include: (a) quantities of mortar in masonry walls; (b) little use of dressed stone, at least in cave sites (Dean 1969); (c) jacal construction in conjunction with masonry; (d) kiva roof construction similar to that of domestic roofs; and (e) open areas containing cists and other features associated with domestic activity.

They differ in that: (a) one finds no entry box complex in de Chelly, whereas the feature is typical of Kayenta (especially during the Tsegi phase); (b) multistory architecture (three or four stories) is common in de Chelly, rare in Kayenta; (c) room blocks, rather than room clusters (Dean 1969), are typical of de Chelly; and (d) plazas are found in de Chelly cliff dwellings, courtyards in those of the Kayenta. Dean (1976: personal communication) notes that plazas are common, however, in Kayenta area open sites.

Comparative Kiva Architecture. The seven excavated kivas at Antelope House comprise the largest sample of kiva architecture from a single site in Canyon de Chelly National Monument. This section compares these kivas with those recorded by de Harport (1959), Steen (1966), Mindeleff (1897) and the Canyon del Muerto Survey (as of 1974).

The traditional Mesa Verde kiva, containing six to eight pilasters, does not occur in Canyon de Chelly. De Harport recorded no kivas with more than two pilasters (1959: 1552) and existing data indicates that kivas with even two pilasters are in the minority; only 10 of 54 kivas recorded

by de Harport, the Canyon del Muerto Survey and Steen have pilasters. Often, as with Kiva C, these pilasters, like other features, have been added following the use and replastering of an original plain form (Mindeleff 1897: 122; Steen 1966: 39). The presence of pilasters is a feature most readily determined by excavation, of course, and their absence in records based on surface observations must be viewed in this light. Note that of the 12 excavated kivas at Tse ta'a (Steen 1966: 20–21) and Antelope House, six have pilasters.

Pilastered kivas, when they do occur, seem to be set apart from non-pilastered units. This is the situation recorded at Tse ta'a, TWT 1 (Pictograph Cave) and CDC 230. At White House, the one pilastered kiva is somewhat separate from the other three. The definite exception to this generalization is Mummy Cave (CDC 174), where the placement of Kiva B, with its aberrant pilasters, is distinguished in no way from that of the five non-pilastered kivas. At CDC 28 and CDC 191, the only kiva noted contained pilasters; conversely, there are large sites (such as, Sliding House, CDC 107) with four to five kivas, none of which appear to have pilasters.

Pilastered kivas (Table 7) occur primarily in sites which contain multiple kivas. The data tends to support the hypothesis that the Antelope House distribution of pilastered kivas is typical of the canyon; that is, pilastered kivas tend to be clustered in one portion of the site. It seems likely, therefore, that the inferences we draw on the basis of this data for Antelope House might reasonably extend to the social structure of other large sites within the canyon.

Corresponding with the absence of the multiple pilastered kiva is the absence of cribbed roofs. There are no known complete or partial kiva roofs remaining in the canyon, but both de Harport and Mindeleff agree that Canyon de Chelly kivas had conventional roofs, like those reported by Morss (1927) for Poncho House. Data bearing on height of roof above floor is not available for most kivas at Canyon de Chelly, but many would appear to satisfy Dean's criterion (1967: 126) of exceptional roof height in ceremonial rooms.

Little information is available on floor features, as would be expected from survey data. Only one occurrence of loom anchors, other than those found at Antelope House, is reported; Richert (1961: 106) recorded a set at Kiva B, Mummy Cave (CDM 174). None were noted at Tse ta'a (Steen 1966).

The correlation between pilasters and kiva mural decorations observed in Antelope House is not supported by data on other kivas in the canyon. De Harport (1959: 151) considered de Chelly the westermost example of kiva mural art in P III times, a trait he said was absent in the Kayenta area, with which de Chelly is closely

Table 7. Canyon de Chelly sites with pilastered kivas (data from de Harport 1959, unless otherwise cited).

Site	*Pilastered Kivas*	*Total Kivas*	*Remarks*
CWC 10	1	2	
CDC 28	1	1	
CDC 75 (White House)	1	4	In several instances, the kiva is partly eroded; presence of two pilasters based on assumption of kiva symmetry.
CDC 86–87 (Tse ta'a)	2	5	Steen, 1966: 20–21
CDC 191	1	1	
CDC 230	2	4	
CDC 174 (Mummy Cave)	1	5	Mindeleff, 1897: 86; Richert, 1961
TWT 1 (Pictograph Cave)	1	2	D. P. Morris: personal observation

linked architecturally. The only kiva in the west with painted decoration is one at Kiet Siel, with one white band around the wall (Lindsay 1969).

The sipapu is rare. At Antelope House the only floor feature which occurs in the traditional sipapu position is a loom anchor loop in Kiva 18. Steen (1966: 21) recorded a possible sipapu in Room 56 at Tsa ta'a. More common is a niche in the wall below the bench top, which lies in the axis of the ventilator shaft/deflector/fireplace.

Kiva 18 at Antelope House is the only rectangular kiva known in Canyon de Chelly. Like the rectangular kivas in the Kayenta area (Lindsay 1969), Kiva 18 is late, smaller and protrudes more above ground than does the classic round kiva.

Review of the data on kiva form and distribution in Canyon de Chelly suggests that differences in kiva architecture, particularly pilastered versus nonpilastered, the general absence of the sipapu and the general presence of sipapu niche, tend to support the assertion that the observed forms and distributions of kivas at Antelope House are typical of contemporaneous large sites throughout the canyon. In Chapter 28, we present a model of social organization at Antelope House which is based in part on the kiva forms at the site. We suggest that this model can reasonably be applied to other contemporaneous sites in the region.

Chapter 6

Site Chronology

The 89 rooms and structure recorded during our excavations at Antelope House were dated on the bases of stratigraphic position and bonding relationships of shared walls. They were assigned calendar dates on the basis of 356 tree-ring dates (Appendix D) and a number of archeomagnetic dates. Where no tree-ring or archeomagnetic dates were available, we relied on the pottery dates established by Breternitz (1966). These dates correspond remarkably well, but some exceptions were noted and are discussed more fully below. The earlier units are more securely dated than later units.

Our excavations retrieved evidence for construction at Antelope House during the Basketmaker III and Pueblo II periods and considerable information about large villages at the site during Pueblo I and Pueblo III periods. Although three tests were made in search of earlier occupations, none was found. All tests reached permanent groundwater without reaching sterile soil, prompting the conclusion that evidence for earlier occupation might be present beneath what we now know as Antelope House.

The tree-ring dates tabulated in Appendix D are impressive in number but poor in quality. The majority of the tree-ring specimens were nondescript chunks of charcoal recovered from secondary refuse in rooms and plaza areas and are thought to have been discarded from hearths. Most of these specimens retain no evidence of the outermost ring and, therefore, are designated "vv," indicating that an unknown number of rings may be gone from the outside of the samples (Bannister *et al.* 1966). The tree-ring dates only partially established construction dates. Only Structure 8 had an intact roof and the beams in that roof were not fashioned from datable species. None of the fill in the areas excavated contained large beams which could be related to collapsed roofs and many of the timbers found in the trash were of undatable species, primarily cottonwood (*Populus* sp.) and willow (*Salix* sp.) The exceptions are easily summarized:

(1) Features 1 and 2 in the Central Plaza were roofed, in part, with ponderosa pine and Douglas fir logs. Feature 1 contained four Douglas fir logs, with cutting dates of 1237B, 1250B, and 1252B. Feature 2 yielded a log with cutting date of 1222B. The smoke blackening and charring on this log and on others in the roof indicate they were recycled from a roof (or roofs) elsewhere in the site. (2) The most firmly dated structure in Antelope House is Structure 67, the earliest at the site. Partial excavation of this unit yielded 29 charred and datable beams, their cutting dates clustering from AD 691 to 693. These beams are the collapsed wall and roof members of the unit. (3) The jacal walls of the Pueblo I units contained beams with cutting dates ranging from AD 828 to 848. In general, however, we lost good tree-ring dating material as we moved up the time scale.

Archeomagnetic samples were collected from burned clay whenever possible by R. E. DuBois, University of Oklahoma, or by one of his workers. Not all hearths or burnt areas were collectable and not all samples were datable. Since slab-lined hearths were used in most structures and in outside cooking areas, little burned clay was present. Because the thick circular clay walls of kiva hearths usually yielded datable clay samples, these structures are over-represented in our report. The archeomagnetic dates generally agree well with statigraphic relationships and with tree-ring dates, but two anomalous situations are discussed below.

In developing the internal construction sequence, attention was paid to two types of wall abutment. In the first type, masonry abuts masonry and both are overlain by a common coat of plaster. This situation suggests, but does not prove, that the wall segments were constructed simultaneously or nearly so. In the second type, masonry of one wall abuts the plaster coat of another wall. This situation implies, but does not prove, that an appreciable interval of use preceded construction of the abutting wall.

The dating of other wall segments and approximate time of construction is based on tree-ring dates in the fill overlying, underlying or within them, on ceramic material and similar association, and on their stratigraphic position relative to similar units at the site.

In developing our bonding and abutting sequence, two discoveries were of particular interest: (1) There are three wall segments to which all other adjacent wall segments abut—WS 75 in the South Room Block, WS 44 in the Central Room Block and WS 26 in the North Room Block. Wall Segment 2 is abutted by all other units of the wall which at one time enclosed Kiva 47. Most of this wall segment was removed prehistorically, but the base courses of the northeast and southeast corners remain intact; strata to the east and north terminate abruptly at the location of the hypothesized wall. We assume that this wall and Kiva 47 were part of the initial construction of the North Room Block at approximately AD 1100. While this assumption may be incorrect, it is exceedingly difficult to date the construction of WS 2 and Kiva 47 later than AD 1140. (2) As this relative sequence was related to calendar year sequence by means of archeomagnetic and tree-ring dates, it became obvious that the Central Plaza, the area bounded by WS 44, slightly post-dated Kiva C. The fill of Kiva C produced tree-ring dtes as late as Ad 1202. Since WS 75 and WS 26 could be dated earlier, the Central Plaza was the latest of these three units to be constructed.

The dated sequence of bonding and abutting relationships to Pueblo III structures shows that the North and South Room Blocks existed contemporaneously for most of the later occupation of the site, with construction of the Central Plaza and attached rooms representing the latest construction period. Extensive remodeling and reconstruction complicate the situation, especially in the South Room Block.

The site chronology developed through synthesis of the kinds of data just described follows.

Basketmaker III

Basketmaker III structures were found side by side at the eastern, eroded edge of the site. Both were built late in the seventh century and both burned, along with their contents. The archeomagnetic date from Structure 67 (770 ± 37) was derived from a burned clay floor ridge and dates destruction of the unit; the extensive assortment of tree-ring dates from burned beams indicates the time of its construction. It would appear that the unit was occupied from just before AD 700 to approximately AD 750. Since the ceramic assemblage (Lino Plain) and other artifacts associated with this unit are typically Basketmaker III, it seems probable that at Antelope House the period persisted somewhat beyond the termination date of AD 700 assigned by de Harport (1959).

The dates associated with the adjacent Structure 59 are less satisfactory. A date of 670 vv was derived from logs in the unit, but a burning date of 960 ± 12 (DuBois Sample No. 677) was taken from a sample of the clay wall. This date cannot be reconciled with the stratigraphy. It is at least 200 years too late and falls after tree-ring dated time of construction of the overlying PI layers.

Stratigraphic test in the D3 square near Kiva A, in the vicinity of Grid Square P3, within Room 1 and within Kiva D (Fig. 2) yielded small samples from strata which appear to be Basketmaker III since they lay beneath Pueblo I units and contained Lino Plain pottery. No datable materials

were recovered from these tests and no architecture was located.

The stratigraphic tests near Kiva A (D3 square) and near the P3 square were continued to the water table, at which point excavations exposed water-deposited sand and silt beds yielding a few Basketmaker III ceramics. Underlying sterile strata at Antelope House are now below the local water table. The closest aproximation to sterile soil occurred in the D3 test, where the sherds within the lowest unit, a pile of talus rubble with voids between the sandstone blocks, surely must have trickled down from the layers above.

Pueblo I

The Pueblo I village at Antelope House covers an area larger than that covered by the Pueblo III site. Pueblo I units were found beneath the South Room Block and ran uniformly into the North Plaza area, where a series of superimposed Pueblo I use surfaces was discovered. Units attributable to this period are Structures 54, 58, 70, 72, 73, 80, 85 and 86 (Fig. 24). Pueblo I strata were found wherever sub-floor testing of the lowest Pueblo III units was done. Pueblo I units located but not excavated include those in the Tower Corridor, those beneath Rooms 1, 16, 21, 44 and Kiva D and those in the middle of the Central Plaza. The typical wall was of jacal construction, using pinyon pine, cottonwood, ponderosa pine or juniper interlaced with willow withes and plastered with smooth tan adobe.

Unfortunately, we do not have a clear idea of the layout of this early Pueblo I village. The construction dates recovered from a variety of jacal walls (Table 8) suggest that the basic unit was constructed during the years AD 825 to 850. Several timbers were reused in later construction or project through the floors of later units and are not presently assignable to their proper Pueblo I structures.

Pueblo II

Since Pueblo I trash and structures lay directly below Pueblo III structures at Antelope House, particularly in the northern portion, it appears that most of the site was abandoned during Pueblo II times, from about AD 950 to

Figure 24. Pueblo I and II units at Antelope House (figures in bold type are room numbers).

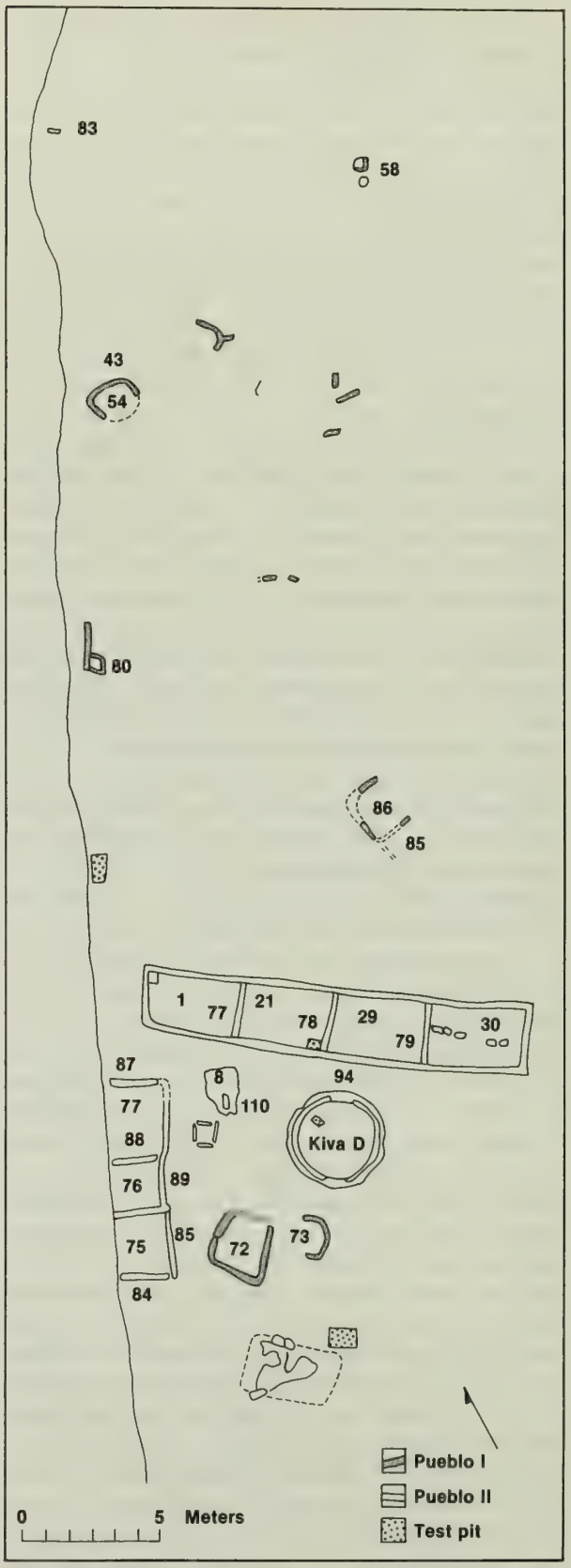


Table 8. Tree-ring dates associated with Pueblo I units.

	Specimen Number	*Date*	*Provenience*	*Species*
Structure 58	AH-243	727fp–815vv	1074	pinyon
Structure 62	AH-201	698–828r		pinyon
Structure 64*	AH-202	742–831cB	surface	juniper
Central Plaza	AH-1	766–841vv	upright in wall of kiva	
Room 15*	AH-357	PMN	upright in floor	
		735fp–848 + vv	near south wall	

*These samples are inferred to be in primary association with underlying, earlier, unexcavated unit.

1100. Pueblo II units are found at the southern end of the site. We do not have a good date for the end of the PI occupation or a good beginning date for the PII. Three-ring dates in the 900's are relatively rare and suggest a hiatus, as there are no cutting dates of any sort during this period. Although there is no sterile stratigraphic layer to indicate a period of abandonment, soil forming processes that operate in open sites apparently do not operate in rock shelter sites like Antelope House. Layers of considerably different uses have no intervening layer to indicate the passage of time. It can be concluded, then, that Antelope House was abandoned, or very nearly so, during Early PII times. The lack of tree-ring dates and of large numbers of structures indicates marked population decrease, at the very least.

Since Pueblo III construction is found north of the small Pueblo II unit and since the North Room Block is somewhat later than the South Room Block, a general pattern of architectural development emerges. Later units were built north of the earliest rooms throughout Pueblo II and III. The development of Antelope House should be considered as continuous, without undue emphasis on the AD 1100 Pueblo II-Pueblo III boundary.

Units constructed during Pueblo II include Kiva D and Rooms 75, 76, and 77 (Fig. 24). The bottommost floors in Rooms 1, 21 23, 29 and 30 related to this phase of construction and a featureless floor fragment immediately west of Room 74, which was separated from its stratigraphic context during the 1906 dig, may have been a part of this village unit. The use surface of the plaza during this time was the feature-filled 130 floor.

The first surface masonry constructions at Antelope House were two room blocks on adjacent sides of a rectangular plaza; they contained a central kiva, numerous hearths, firepits, structures and subsurface embedded jars, establishing a pattern which persisted for the next 200 years. We cannot say with certainty which of the room blocks was constructed earlier, but it seems evident that of the three rooms built against the cliff base, Rooms 76 and 77 were constructed as a unit and Room 75 was added later. Rooms 1, 21, 29 and 30 were built as a unit, sharing a common boundary wall with bonded corners. Interior walls subdivide this large rectangle into rooms. These units share the exterior use surface referred to in our notes as the 129 floor. It is probable, therefore, that the units were built at about the same time. The low walls and lack of wall rubble indicate that Rooms 75, 76 and 77 were abandoned and torn down with the intent of using the rocks in construction of other units, including those added to the unit containing Rooms 1, 21, 29 and 30 sometime around AD 1100. Kiva C was constructed at this time and Kiva D probably was abandoned. This shift to the north may be explained by evidence of a rock fall found in Kiva D. The walls of this kiva were badly damaged and fragments of boulders, which can be nothing other than spalls from the cliff, were embedded in the floor; they had smashed the hearth and some of the kiva wall. A related series of boulders, including the large boulder overlying Structure 73, was found outside the South Plaza kiva. The clean floor and lack of roof beams with this rock fall suggest that the inhabitants anticipated the fall and so abandoned the kiva and adjacent rooms.

Pueblo III

Pueblo III architecture is discussed in the following pages in terms of the development of the South, North and Central Room Blocks.

South Room Block. The South Room Block includes the architectural features and room which developed from the initial construction of Rooms 1, 21, 29 and 30 and which related directly to those units. This unit contains virtually all of the multistory architecture present at the site. The rooms in this unit are much larger and more uniform in size than those elsewhere in the site and there is a tendency toward more elaborate decoration of wall surfaces.

As shown in Figure 25, the first addition to the initial room block (that enclosed by WS 75) is WS 61, the unit enclosing Rooms 2 and 3. We cannot determine the original height of this construction, since only basal courses remain. Wall Segment 103 was constructed next, enclosing Rooms 9 and 10, followed by WS 72 and WS 73, enclosing Rooms 22 and 78. It is likely that a third room east of 78 was also part of this addition, but its existence can be neither demonstrated nor denied. The very regular construction of rooms in this area would seem to predict a north-south wall forming the east boundary of Room 78 at the point where rooms 29 and 30 are divided, but no evidence for that wall could be found; the later intrusion of Kiva A in this area disturbed the archeological record.

Further development of the South Room Block was confined to additions to and later remodeling of these 10 rooms (Fig. 26).

Wall Segment 76 was placed above the existing WS 75 in Room 1, which eventually rose to a height of four stories. The existence of this four-story unit is documented by the presence directly above Room 1 of plaster outlines on the cliff face, showing locations of walls and floor levels. The wall segment itself now reaches no higher than the second story at any point and it is possible that other wall segments, now collapsed, may have been involved in the eventual evolution of the unit above Room 1.

Wall Segment 89 and the unit above it, WS 118, still stand, forming the north wall of Rooms 3 and 10. At no point does WS 89 touch WS 76, making it impossible to determine whether the two constructions are contemporaneous or, if not, which is earlier. Whatever the case may

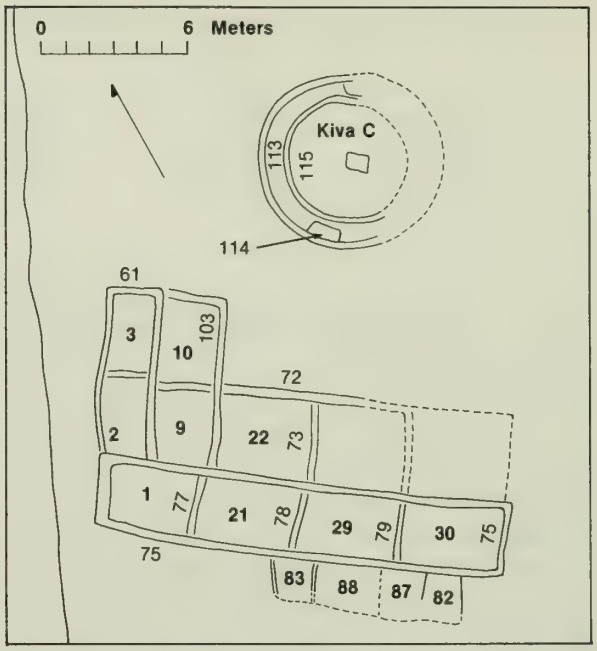


Figure 25. Original Pueblo III construction in the South Room Block (figures in bold type are room numbers).

Figure 26. Additions to and remodeling of the South Room Block (figures in bold type are room numbers).

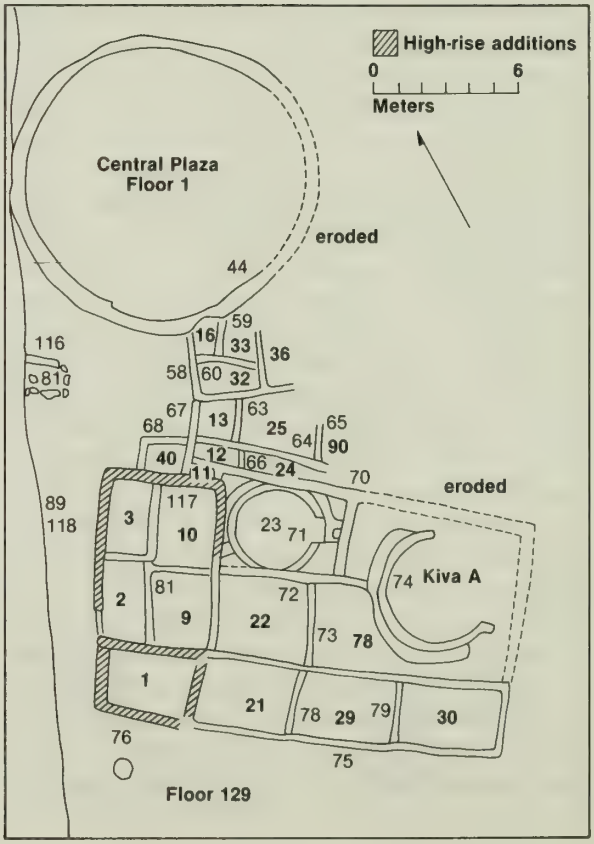


Table 9. Tree-ring dates from Provenience 123, South Plaza (excluding six earlier dates, one of 978 vv).

Specimen Number	*Ending Date*	*Source*
AH-596	1112 vv	charcoal fragments
	1105 vv	charcoal fragments
AH-279	1061 vv	charcoal fragments
AH-586	1076 vv	charcoal fragments
AH-282	1057 vv	charcoal fragments
AH-284	1050 vv	charcoal fragments

have been, the time of their construction was very close. In contrast to earlier construction, WS 89 runs around the outer boundaries of Rooms 3, 10 and, presumably, 9. Wall Segment 117 partitions Rooms 3 and 10.

The construction of these high-rise units divides Early Pueblo III from Middle Pueblo III. As used here, these labels are intended to apply only to Antelope House; they do not necessarily have relevance outside the site. The break is dated at approximately AD 1140, primarily on the basis of tree-ring dates from strata which abut WS 76 in the South Plaza. Since these eroded charcoal specimens do not adequately represent the time of cutting, a date of approximately 1140 is inferred; the date is intermediate between 1112, the latest date in the stratum, and 1209 vv, the date from the overlying stratum, Provenience 123 (Table 9). This date agrees with the ceramic assemblage. The date is also consistent with dates from the upper levels of Rooms 1 and 21. Provenience 123 is a large layer of turkey dung immediately below the footing of WS 76.

Provenience 122, which abuts WS 76 and overlies Provenience 123, yielded one date of 1209 vv (AH-614), which indicates a very gross upper limit for its construction.

At about AD 1140, upper floor levels built over trash appear in Rooms 1, 21 and 29. Floor 4, Room 1, is interpreted as the new use surface associated with this remodeling. The compact clay of the fill and the homogeneous ceramics below Floor 4 may have been placed as a footing or foundation for the massive WS 76, which suggests that the eventual four-story height of this room was planned from the outset. A portion of the south-west corner of WS 76 was footed on loose trash outside the room, creating instability which eventually resulted in massive wall collapse into the South Plaza.

With somewhat less certainty, Floor 3, Room 21, and Floor 4, Room 29, are considered temporally equivalent to Floor 4, Room 1. Room 30 may well have remained unmodified throughout this period.

During Late Pueblo III, following the deposition of considerable trash, remodeling produced the set of upper floors in Rooms 1, 2, 9, 21, 29 and 30. A test pit determined that Room 3 has only one floor, which was built at the base of the earliest wall (WS 61) placed to form the room. The situation is not known in Rooms 78 and 10, which were not excavated. The upper floors are associated with additional unnumbered wall segments above the older constructions, indicating remodeling and rebuilding of these rooms. The largest and most extensive is WS 81, an L-shaped wall which repartitions Rooms 2, 9, and 10. It is footed on loose trash fill. The west wall of Room 2 shows two wall segments (90 and 91) above WS 59. Wall Segment 82, atop WS 103 on the east wall of Room 9, also relates to this remodeling episode. A few stones atop Wall Segments 77, 78 and 79 are the basal courses of new units representing new construction correlated with high floors in Rooms 1, 21 and 29, but these stones were not assigned wall segment numbers. This remodeling occurred sometime after AD 1200, as indicated by archeomagnetic dates from associated hearths in Rooms 1 and 29.

North Room Block. Examination of the bonding and abutting sequences in the North Room Block, the area north of the Central Plaza, shows clearly that the unit consisting of Rooms 39 and 16 (originally one room), Room 35 and a room to the east of Room 35, most of which has been destroyed by erosion, was the earliest unit in this portion of Antelope House. All surrounding walls abut this unit, designated WS 26 (Fig.

27). Wall Segment 2, an enclosure for Kiva 47, is also abutted by all wall segments which touch it; this assertion is tenuous because of the fragmentary nature of the wall segment, but its northeast and southeast corners are still in place and are clearly bonded corners. The preponderance of evidence indicates a room block to the south, with one kiva enclosed by a rectangular wall slightly to the north, a very common pueblo site plan. The remainder of the rooms at the site were added piecemeal to the two original units (Fig. 28).

Few tree-ring dates are available for the Pueblo rooms in the north end of the site. The beginning of construction of the North Room Block is indicated only approximately by sample AH-81 from Provenience 506, Room 39, which yielded a date of 1102 vv (Table 10). This date can easily be off by several decades, but the ceramic assemblage is consistent with fill from the Middle to Late Pueblo III period, indicating construction at about AD 1100 or up to 30 years later. It is highly probable that the North Room Block was begun about 50 years after the beginning of the South Room Block.

This construction sequence shows that Kiva 47 was used for a comparatively long time, since it yielded the latest archeomagnetic and tree-ring dates at the site. Stratigraphically, however, Kiva 18 is demonstrably later than Kiva 47. The evidence here involves the destruction of WS 2 (the original kiva enclosure wall), the filling of this area with trash and the construction of WS 23, which lay against that trash (Fig. 29).

While the archeomagnetic date from Kiva 18 (1234 ± 17: Dubois #855), is earlier than that from Kiva 47 (1250 ± 23: DuBois #857), the standard deviations of the two dates overlap. The late tree-ring dates of 1256 and 1260+ + vv would be expectable in the very late refuse and fill of the kiva. Provenience 1148, which contained the 1260+ + vv specimen, is a fill provenience; it partially overlaps the circular kiva wall and extends into the area between Kivas 47 and 18. The later sample, then, may be fireplace charcoal from Kiva 18. Abutting Kiva 18 on the east is Room 41, a very small room with three jacal walls.

Room 41 is directly above an unusual deposit, referred to in our notes as the North Room Block hard-pack or north trash (Fig. 29). This deposit extends over the north wall of Rooms 35

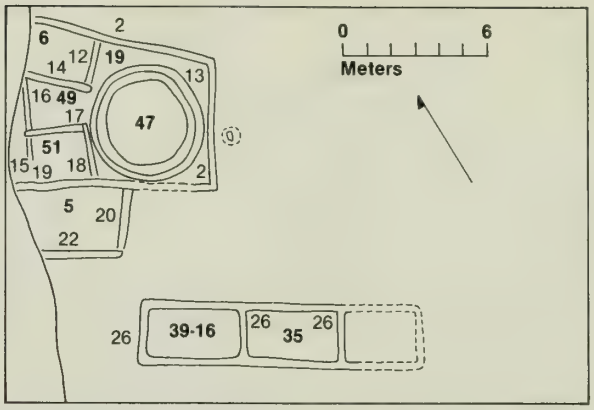


Figure 27. Original Pueblo III construction in the North Room Block (figures in bold type are room numbers).

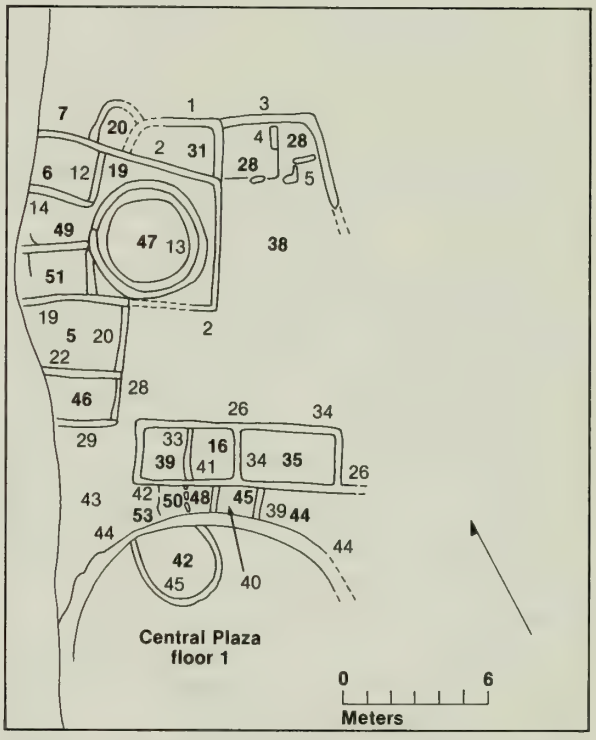


Figure 28. Additions to and remodeling of the North Room Block (figures in bold type are room numbers).

and 16, the open plaza area and an unknown area to the east of the site. It is definitely Pueblo III, but earlier than Room 41, which is Late Pueblo III.

Ringing the North Room Block hard-pack are: Room 37, a slab-lined storage unit set into the hard-pack at essentially its southern boundary; Feature 1, Room 35, a similar unit somewhat farther west; Room 39 and Kiva 18 on the west, and Room 28, a habitation unit on the north.

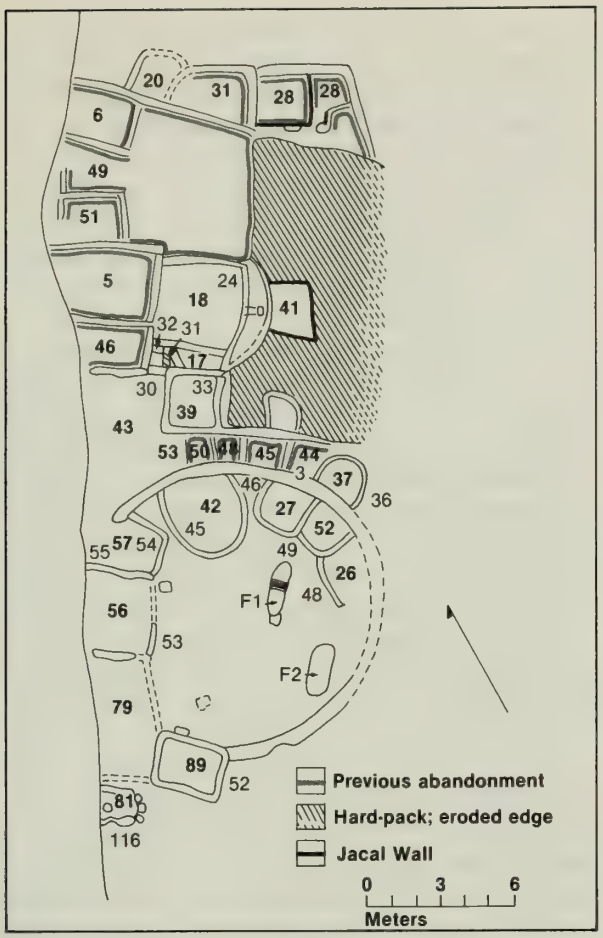


Figure 29. Later additions to the North and Central Room Blocks (figures in bold type are room numbers).

Table 10. Tree-ring dates from room proveniences, North Room Block (excluding six earlier dates).

	Specimen Number	*Date*	*Provenience*
Room 5	AH-226	979vv	1027
	AH-229	869vv	900
Room 16	AH-80	964vv	470
	AH-81	1102vv	506
Room 17	AH-41	492vv	565, 566, 568, 569
Kiva 18	AH-43	1066vv	
	AH-13	1096vv	
	AH-233	1117vv	1043 (Feature 1)
	AH-232	770vv	1039 (Feature 1)
	AH-359	733vv	1144 (Feature 2)
Room 19	AH-47	1032vv	552
	AH-45	1039vv	
	AH-46	1114vv	
	AH-44	1211vv	
Room 31	AH-60	1016vv	586, 589, 594
	AH-59	1048vv	
	AH-58	1059vv	
Room 41	AH-62	1093vv	
	AH-61	1083vv	
Room 43	AH-64	841vv	583,596
Room 46	AH-65	1127vv	601
Kiva 47	AH-465	1260++vv	1148
	AH-468	1256vv	604
	AH-464	1134vv	1152
	AH-462	1133vv	1155
	AH-460	1130vv	
	AH-461	1127vv	

We do not clearly understand how the hard-pack was produced, although it is definitely prehistoric and not due to Navajo or historic use and occupation of the site. The deposit is a series of hard surfaces extending over a roughly rectangular area, measuring 4.5 m × 1.2 m. Its maximum thickness is approximately 60 cm near Rooms 35 and 16, thinning to 5 cm near Room 28. The strata of the deposit dip gently south to north, although the beds overlying Room 6 tilt downward from west to east. The original extent of the now eroded deposit to the east is unknown.

The numerous thin sandy laminae (each 2 mm to 10 mm thick) within this deposit suggest water deposition. Interspersed between the laminae are small layers of fragments of predominantly vegetal material, which have the appearance of having been pounded and shredded. The fragments are well preserved. Thus, although water seems to have been involved in deposition, it was not present in sufficient quantities or for sufficiently long periods to cause appreciable rotting or deterioration of vegetal material; this indicates the intermittent application of water by cultural means, rather than a natural process. The deposit is topographically very high and is surrounded on all sides by lower material. The only existing higher ground now known is the fill of the South Room Block, the dry and uncompacted nature of which indicates that it was not the source of the deposit. Unfortunately, we have no idea what may have existed east of the hard-pack.

Central Room Block. The Central Room Block includes all those units abutting the circular wall of the Central Plaza and those stratigraphically above the wall. Walls and rooms which abut the walls of Rooms 3, 10 or 23 of the South Room Block or Rooms 16, 35 and 39 of the North Room Block are also part of the Central Room Block. On one level, the designation "Central Room Block" simply serves as an artifical device for segmentation of the archeological record. Certain distinctive qualities of the architecture of this unit, however, indicate a real entity in the cultural systems operating at Antelope House. Since construction of the Central Plaza is dated after AD 1200, due to its stratigraphic position over Kiva C, all units discussed here, with the exceptions of Room 54 and Structure 80, also post-date AD 1200.

The Central Plaza wall rested upon a well–defined but occasionally rough–use surface immediately underlain by unexcavated Pueblo I structures. The cleared portion of this lower surface was featureless. Our inference is that the interior of the Central Plaza as initially designed was essentially clear and flat. Eventually, 30 cm of fill (P129 and P130) containing abundant turkey feces was deposited over this lower floor and a second packed clay floor (P218) was constructed. All Central Room Block features, hearths and rooms shown on Fig. 29 relate to and develop from this later floor. This shift in architectural patterning indicates a major revision in the use of this portion of the site. Rooms 89, 79, 56 and 57, all but 89 containing hearths, have walls and floors stratigraphically above the wall of the Central Plaza (WS 44), indicating that the plaza wall, which presumably stood as tall here as it does near Room 15, was removed to make way for these habitation units.

Kiva 42 abuts the original Central Plaza wall (WS 44), as do the three small units (Rooms 27, 52 and 26) east of the kiva. No direct dates were obtained from any of these units, but the stratigraphic position and the slight accumulation of refuse in the Central Plaza indicate that they are among the latest in the site.

Six small rooms fill the space between the core unit of the North Room Block and the Central Plaza. Unfortunately, there are no direct dates from any of these units. They could have been constructed early or late in the development of the Central Room Block, but their size strongly suggests their use for storage. Area 43, at the very rear of the rock shelter (Fig. 29), served as an annex to the Central Plaza. A clearly defined doorway opening through the area later covered by Room 57 gave access from the annex to the Central Plaza. Like other features lying north of the center of the site, Room 43, the analogue of the Central Plaza Annex to the south, is smaller than its counterpart in the southern portion of Antelope House.

A plaster line at the southwest exterior corner of Room 39 demonstrates the previous existence of a wall running due south from that position. Since no corresponding plaster line occurs on the Central Plaza wall, the prior existence of a room, demolished to construct the Central Plaza, is inferred. The other wall of this hypothetical room cannot be located. It is interesting to note that if this room did exist, pre-1200 Antelope House presented a symmetrical ground plan oriented on a principal axis running east-west through the area in which the Central Plaza would later be constructed.

Room 37, the easternmost of the small storage units abutting the Central Plaza to the east, differs in ground plan from Rooms 53, 50, 48, 45 and 44, which occupy the rest of this area; it is built of upright slabs in an essentially circular outline. Wall Segment 36, which encompasses the unit, is later than others in this area and is related to and later than the North Room Block hard-pack. In all of these characteristics, it is comparable to and contemporaneous with Feature 1, Room 35.

The units south of the Central Plaza present a more complex picture. The space between the Central Plaza and the wall of Rooms 3, 10 and 23 was filled by a series of piecemeal constructions (Fig. 26), resulting in two habitation rooms (25 and 36) and the evolution of seven very small rooms (11, 12, 13, 16, 24, 32 and 33).

Room 25 began as a habitation room, complete with hearth, but was remodeled to a featureless unit. Remodeling included placing a different colored clay on the original wall and floor plaster, with particular emphasis on a massive cove at the base of the wall. The hearth was filled with material of the same texture. Such an addition, particularly the heavy coving at the base of the wall, is consistent with hypothesized alteration of room function to storage, since the coving would tend to rodent-proof the room

(Dean 1969). Other storage units at the site lack this cove. The placement of a second floor in Room 36 may relate to remodeling of Room 25; another habitation unit may have been built to the east. This cannot be proved, however, since roughly half of Room 36, a portion of Room 25, nearly all of Room 90 and any other units which may have existed in that area were lost through erosion. Eventual demarcation of rooms to the rear of these two living units seems to have been due to a process of remodeling through the addition of interior walls, dividing larger spaces into progressively smaller spaces.

The bonding and abutting sequence involving WS 70, which superficially appears to be part of the South Room Block, indicates an arbitrary element in the division into South, Central and North Room Blocks for analysis. Wall Segment 70, and hence the units we can confidently associate with it (Room 23 and Kiva A), post-date construction of WS 67, WS 58 and, therefore, the Central Plaza. Their size and position alone suggest relationship with the South Room Block (Fig. 26).

A provocative implication in the construction sequence is that during the interval between the filling of Kiva C and the construction of WS 70 and Kiva A (AD 1200–1230), the inhabitants of the South Room Block either did not use a traditional kiva or vested such use in a kiva that has since eroded away. At the same time, however, Room 47 in the North Room Block continued to function as a kiva.

The last Anasazi construction in the Central Room Block was the excavation and elaborate roofing of Feature 1 in the Central Plaza (Fig. 29). Construction of Feature 2 may have preceded Feature 1 by as much as 30 years, judged on the basis of included tree-ring dates (AD 1222 and AD 1252). Since the logs yielding these dates show signs of previous use, actual construction is somewhat later than the tree-ring dates indicate. No Navajo period artifacts were found in association and the features and their artifact content support their assignment to the Anasazi period.

Abandonment of the Site

AD 1270 is a reasonable date for the abandonment of Antelope House, following a prehistoric occupation of 220 years. The latest tree-ring date at Antelope House (AD 1260+ + vv, representing fireplace charcoal from the fill refuse above Kiva 47) buttresses the essential validity of this date. Had Antelope House been inhabited significantly later than AD 1270, later ceramic types should have appeared in the collection. Nearby CDM 11, for example, yielded Kayenta polychrome sherds representative of the very late Pueblo III period (AD 1270–1300). The absence of these materials at Antelope House suggests that the site was abandoned by that time.

A possible exception to this generalization stems from a tentative 14th–century archeomagnetic date from the hearth in Room 38. In addition, the hearth in Room 41, one of the latest in the site and one of those closest to the surface, may date to either AD 1380 or 1140. None of the dates are considered totally credible by R. L. DuBois, since they are derived from incomplete sample sets of burned clay. Should the dates prove accurate, or should one accept them for purposes of argument, they still do not disprove the proposition that the site was abandoned by AD 1270; the dates could suggest camping by transients in the area, either Anasazi or possibly even Athabaskan. There is no late ceramic material or other evidence corresponding to these late archeomagnetic dates.

The relative lack of artifacts on the late floors at Antelope House also is explained by the AD 1270 abandonment date, since populations remaining elsewhere in the canyon could easily have stripped Antelope House of whatever easily portable material was present at the site, perhaps including roof beams.

The only Navajo architectural modification of Antelope House occurred when Rooms 4 and 14 were remodeled from Room 89. Dan Anagal stated that his family used these units "before the war (WW II)." Several early photographs (1900) show these units intact and presumably in use.

Chapter 7

Architecture and Social Organization

When constructing a house or room, it is obvious that certain activities must precede others—in Pueblo architecture one must build the walls before constructing the roof—but few detailed discussions of aboriginal building practices before the impact of modern technology are available. The discussion presented here is based primarily upon Mindeleff's (1891) data, the most comprehensive source for discussion of Hopi ritual activities associated with house construction.

It is often said that Pueblo males built the walls (see Hill 1970), while women performed the less strenuous tasks, such as wall plastering. Some ethnographic sources, however, suggest that this picture is not always accurate. James (1903: 37) notes that "Hopi houses are owned and built (in the main) by the women." Although husbands generally perform most of the heavy labor, such as bringing roof timbers to the construction site and handling heavier rocks, James states that the basic construction is done by women. Women specifically are reported handling such laborious tasks as masonry, adobe mixing and transportation of wall stone (James 1903: 38). Beaglehole (1937) also records women working as stonemasons.

These sources suggest that masonry construction can be regarded as a female-related activity, but it is more reasonable to make no assumptions in the model relative to the sex of the masons in prehistoric Anasazi groups; a host of *ad hoc* situational variables probably determined who actually did the work. There are certainly no objects incorporated into the architecture of the site which women would have been incapable of moving.

Presented in this chapter are some elementary conclusions about the social groups in which these builders operated. "Group" here is defined as a number of people who interact on a face-to-face basis with each other more than with outsiders (Rohn 1971: 40; Lindsay 1969); in such a situation one may anticipate the development of distinctive styles and practices. The method of recruitment of new members by these groups is not at issue in this discussion; a study based on architectural remains generally detects only those social units organized on a residential principle.

Because architectural remains are primarily *de facto* refuse, we need not make those assumptions generally made when analyzing portable material in secondary contexts (e.g., discard occurs near the habitations of the hypothesized social groups). With architecture, we assume only that individuals knew what they needed for structures and that they built them, using techniques and practices distinctive of the group. These practices may persist through time, producing distinctive architectural styles in the rooms associated with the group. In Chapter 27, we contrast the results of architectural analysis with distributional studies of the portable artifacts to increase our understanding of these hypothesized social units.

Social Organization

The results and interpretations of the architectural analysis are now presented to test the following hypothesis:

> "The North and South Room Blocks represent the residences of distinct but structurally similar social units, while the Central Room Block represents a third dissimilar unit."

The hypothesis assumes that structurally similar social units will erect similar architectural units. If the hypothesis is invalid, there will be no clustering of architectural variables, with elements occurring more or less at random throughout the site. If the North and South Room Blocks are the products of the activities of localized residence groups with distinctive building traditions, there should be non-random distribution of the attributes discussed in Chapter 6.

Variations in form, construction technique and style, as well as the occurrence of these variations within the site, are discussed here in terms of test implications for this proposition. Architectural differences are presented in Table 11.

The first variable noted is the more frequent occurrence of multistory architecture in the South Room Block. Since many of these walls stand, a number of variables can be most economically explained by the greater expanse of wall recorded there; variables 5, 7, 11, 16 and 17 fall into this category and are relevant to the hypothesis.

Thus, there is a southern portion of the site with markedly taller and significantly larger rooms. Additions to this area were made on multi-room units, rather than in the single unit additions characteristic of the North Room Block. The walls of the southern rooms characteristically are coated with thin, smooth, often white plaster. The only walls showing pecking and grinding of component stones occur in the south, the only specialized grinding room is found in the South Room Block and elaborate metate bins occur nowhere else in the site.

Table 11: Architectural variability.

1. Multistory architecture is much more common in the South Room Block (three rooms with four stories, one with three, four with two) than in the North Room Block (one room with two stories).
2. Average room size is 71 percent smaller in the North Room Block than in the South. This is also true of kivas, which are 75 percent smaller in the North Room Block.
3. Construction of the South Room Block proceeded by larger increments than did that of the North Room Block. These increments generally included at least two rooms in the South Room Block, one room in the North Room Block.
4. Smooth, thin plaster is more common (in terms both of number of occurrences and of area covered) in the south than in the north: this is also true of white plaster.
5. Pictographs are found only on the walls of the South Room Block.
6. Each of the four kivas in the southern portion of the site contains two pilasters; none of the three in the north evidence such features.
7. Wall pegs occur only in the South Room Block.
8. Toeholds in walls are found only in the North Room Block.
9. Wall niches, other than sipapu niches, are absent from the South Room Block, while seven are present in the north and central portions of the site; this is contrary to expectations based on the amount of surviving masonry.
10. Recycled adobe clods, used as building blocks in later wall construction, occur only in the North Room Block.
11. The vast majority of windows and doors occur in the South Room Block.
12. Corner abutments are concentrated (six of seven examples) in the North Room Block.
13. The South Room Block contains the only formal specialized grinding room.
14. Rectangular hearths placed against walls are concentrated in the north; none occur in the South Room Block.
15. All painted decoration in kivas occurs in the southern portion of the site. The one instance of incised decoration of a kiva occurs in Kiva 18, North Room Block.
16. Roof construction in the South Room Block seems more substantial, with primary beams supporting secondary beams approximately 5 to 8 cm in diameter. Only one North Room Block example (Room 5) provides data, however.
17. Edge-chipped stones are more common in the South Room Block.
18. Pecked and ground building stones are confined to the South Room Block.
19. Slab-lined cists in rooms are found only in the South Room Block.
20. All elaborate metate bins (those with collecting basins) occur in the South Room Block; most bins occur in the South Room Block.
21. There are no walls thicker than standard (20 to 25 cm) in the North Room Block.
22. Pictographs are clustered on the wall of the rock shelter to the south. This difference is not explained by differential preservation.

The southern kivas contain two pilasters, unlike those of the north, which had none. All painted decoration of kivas occurs in the south, a dichotomy consistent with the greater numbers of white pictographs and instances of white plastering in the south. The kivas of the southern portion are larger than those of the north. Consistent differences of this sort in kiva architecture support the hypothesis particularly well.

Two features are unique to the North Room Block: (1) toeholds built into walls occur only there and (2) the use of recycled adobe clods is confined to that portion of the site. Six of the seven examples of abutting corners occur in the north and rectangular hearths set against walls occur predominantly in that area; only one such hearth was found in the South Room Block (Room 22). All seven wall niches occur in the north and central sections of the site, despite the greater amount of wall in the South Room Block.

Not all is variation and contrast between the North and South Room Blocks, however. The type and amount of chinking shows no particular pattern. Most building stones throughout the site show a broken, unaltered face as set in the wall. Edge-chipped building stones are more common in the South Room Block, but this is directly related to the earlier beginnings of the unit; the use of this type of building stone diminishes uniformly in both room blocks in later periods. Loom anchors appear in all late kivas in both room blocks. There are no differences in mortar type or color, such as those observed by Rohn (1971:46–47). All building stones come from the same apparent source.

The differences in architecture can be demonstrated to be the results not of differential access to rather common resources (with the exception of the white plastering material), but rather on the manipulations of these materials to achieve essentially similar ends: the provision of structures for everyday living, for storage of needed goods and for relatively specialized ceremonial functions. The differences suggest that the builders of the North and South Room Blocks, although contemporaries, held different concepts of a suitable kiva, the dimensions for a habitation structure, the most reasonable placement and types of interior features and the appropriate means of interior finish decoration.

Although the South Room Block was built earlier than the North Room Block, they were largely contemporaneous in period of use. Both units contained essentially the same types of structures. The South Room Block was more elaborate than the North Room Block, with frequent multistory rooms which were larger and more elaborately plastered than those of the North Room Block. South Room Block kivas were larger and each contained two pilasters and wall decorations. Toward the end of occupation in Late Pueblo III, many of the rooms in the North Room Block were filled and abandoned. New rooms were built in the extensively remodeled Central Plaza.

Since the units are demonstrably contemporaneous, the most economical explanation is the existence of two social groups alike in more ways than not, but with consistently distinguishable differences, which co-existed for 250 years. The architectural data tend to support the hypothesis proposed at the beginning of this section.

What explanation is there for the differences between the two groups? Recall that the southern group is distinguished by more frequent use of white plaster and by multistory architecture; the only sources for the white plaster are on the plateau and in areas outside the canyon. Survey work in the region shows that the plateau contains sites of the Basketmaker III through Early Pueblo III stages. The site contains Dogoszhi Black-on-white ceramics and no later types, suggesting that the sites were abandoned by 1150 (Colton 1955) or 1200 (Breternitz 1966), the time that high-rise architecture appeared in the South Room Block. This correlation suggests that high-rise architecture is an adaptation to a population influx, and that the objective of this adaptation was to retain as much agriculture land as possible in a productive state. The paleoclimatic reconstruction (Chapter 9) depicts this period as a time of mild drought, which would provide the impetus for abandonment of the plateau and require more efficient utilization of the canyon bottomland.

The high-rise construction in the South Room Block, therefore, might indicate movement into Antelope House by a closely allied group from the plateau. This hypothesis can be tested by examination of the material residue from the two room blocks; if it is true, plateau-related materials and trade items should be more common in South Room Block trash than in that of the North

Room Block.

An alternative hypothesis is that the large rock slab and rockshelter configuration of the South Plaza effectively limited site expansion to the south, that the North Room Block limited expansion to the north and that there was no place to build but up in response to internal population growth.

The former hypothesis suggests two groups, one with easier access to non-local resources, and implies relative social ranking, dominance and greater wealth. The latter suggests two essentially equivalent groups, one of which happens to build more imposing architecture as a response to local site topography.

Further confirmation of our original hypothesis is sought in the analysis of other aspects of material culture. A major goal is to better understand the relationship of the Central Plaza and the Central Room Block to the units on either side. The abandonment of Rooms 35 and 16 by Late PIII times and the development of habitation and storage units within the Central Plaza suggest that the inhabitants of the North Room Block moved slightly to the south.

Site Population

Site population estimates in Southwestern archeology usually are based on architectural data for good reason (see Plog 1975), but significant difficulties develop with the necessary assumptions about seasonality, contemporaneity of residence units, ratios of people to available space and completeness of the archeological record. The influence of these variables makes estimates no more than reasonable guesses.

On the basis of fecal analysis (Chapter 15), Antelope House is considered to have been occupied year-round. The archeological record is known to be incomplete in two respects: (1) an unknown number of rooms have been lost to erosion, especially in the North Room Block, and (2) no floor features are available for the upper story floors in Rooms 1, 3, 10, 21, 30, 22, 78, 9, 2 and 5. These unavailable data act as a check on the assumptions that all the rooms assigned to a temporal period by the archeologist were occupied simultaneously. For purposes of population estimates, all PII, Early PIII and Late PIII units are assumed to have been occupied contemporaneously on at least one occasion during the period in question. We are, therefore, estimating population maxima for these periods.

Population estimates have frequently been made on the basis of some derived average of inhabitants per room, based either on all rooms or on specialized functional types (Hayes 1975: 183). The conversion factor is generally based on modern Pueblo data. An alternative technique is Naroll's formula (1962), which is based on relationships between population and roofed structural area in a worldwide ethnographic sample, yielding a space requirement of about 10 m^2 per person. Naroll's formula is expressed as follows (A min = minimum roofed structural area; A max = maximum roofed structural area; A of = other function area):

$$\frac{\text{A min} + \text{A of}}{10} = \text{population, minimum}$$

$$\frac{\text{A max} + \text{A of}}{10} = \text{population, maximum}$$

Because of uncertainty about the contemporaneity of structures and rooms and about the function of some rooms, both a maximum and a minimum estimate are presented in Tables 12, 13 and 14. The minimum estimate includes only well–dated rooms with clear habitation characteristics. The maximum estimate assumes that upper stories were for habitation, that dating is accurate, etc. A range of possible variation is clearly established.

Naroll's formula yields much lower estimates than those provided by Pueblo analogy (Fig. 30), indicating that a maximum of 30 to 35 people occupied the site. Population estimates based on Pueblo analogy range from 20 to 165.

The extreme estimates, of course, are difficult to rationalize. A reasonably conservative estimate would be about 50 for Middle PIII and Late PIII, with an Early PIII population of about 40. These figures are higher than the extreme estimates derived from Naroll's formula, but those figures are based on roofed area. Since, in a way, the entire site is roofed, less constructed roof may have been required by the population.

What is significant about the population curve is the rise from Early PIII to Middle PIII and the general steady state into Late PIII. The annual increase is on the order of 1 percent, a plausible rate. It is highly likely that this increase

Table 12: Early PIII population estimate.

Habit. Rm #	*Area*	*Min. Units*	*Upper Stories*	*Total area w/upper stories*	*Total units*	
75	6.1	1	—	6.1	1	
77	7.6	1	—	7.6	1	
29	9.7	1	1	19.4	2	Average room
35	6.2	1	—	6.2	1	size = 8.39
(Min. Total)	29.6	4			5	
21	9.7	1	1	19.4	2	
1	8.5	1	1	17.0	2	
16–39	7.5	1	1	15.0	2	
2	6.4	1	—	6.4	1	
3	5.8	1	—	5.8	1	
9	7.7	1	—	7.7	1	
10	8.3	1	—	8.3	1	
22	12.7	1	—	12.7	1	Average room
78	12.9	1	—	12.9	1	size = 8.39
	109.1	13	Maximum Total	144.5	12	

Other functions	
8—storage	.8
30—grinding	−10.8
76—storage	4.1
KvC—ceremonial	19.6
KvD—ceremonial	9.2
Kv47—ceremonial	10.0
TOTAL	54.5

$$\text{MIN}\ \frac{29.6 + 54.5}{10} = 8.4$$

$$\text{MAX}\ \frac{144.5 + 54.5}{10} = 19.9$$

Table 13: Middle PIII population estimates.

Habit. Rm #	*Area*	*Min. Units*	*Upper Stories*	*Total area w/upper stories*	*Total Units*	
5	11.3	1	1	22.6	2	
35	6.2	1	—	6.2	1	
28	7.1	1	—	7.1	1	
39	7.5	1	—	7.5	1	
6	5.9	1	—	5.9	1	Average room
51	3.7	1	—	3.7	1	size = 8.22
(Min. Total)	41.7	6		53.0	7	
1	8.5	1	3	34.0	4	
2	6.4	1	1	12.8	2	
3	5.8	1	3	17.4	4	
9	7.7	1	1	15.4	2	
10	8.3	1	3	33.2	4	
21	9.7	1	2	29.1	3	
22	12.7	1	1	25.4	2	
29	9.7	1	1	19.4	2	
78	12.9	1	1	25.8	2	
	123.4	15	Maximum Total	265.5	32	

Other Functions					
7	4.0	82—	3.5		
30	10.8	83	4.6		
31	5.3	84	3.0		
Kv 47	10.0	87	5.2		
49	5.0	88	3.2		
		TOTAL	54.6		

$$\text{MIN}\ \frac{41.7 + 54.6}{10} = 9.6$$

$$\text{MAX}\ \frac{265.5 + 54.6}{10} = 32.0$$

is due more to population shifts from the plateau to the canyon floor than to internal growth; the increase at Antelope House could be accounted for by the abandonment of only one or two plateau sites. The size of the population at Antelope House suggests that Steen's estimate of a population of 300 to 350 for the entire canyon is overly conservative; we would expect that de Harport's estimate of 800 for de Chelly is more reasonable. A relative close guess for the entire del Muerto-de Chelly-Monument Canyon population in PIII times would be on the order of 2000, indicating that about 2 pecent of the total population lived at Antelope House.

Figure 30. Estimates of Pueblo III population at Antelope House, derived by application of Naroll's formula (top) and through ethnographic analogy.

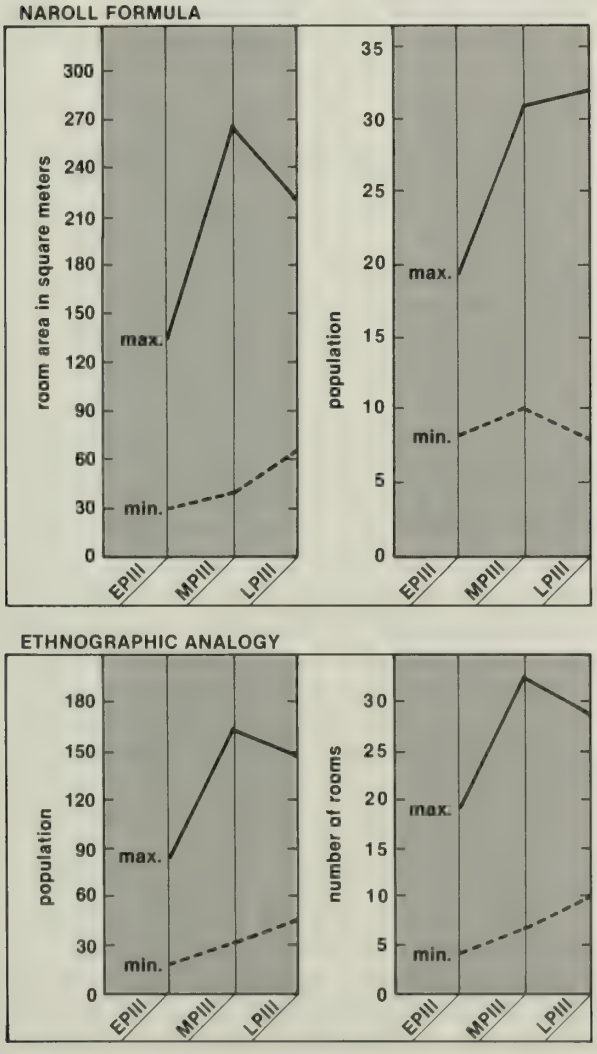


Table 14: Late PIII population estimate.

Habit. Rm #	*Area*	*Upper Stories*	*Total area w/upper stories*	*Total Units*
1	8.5	2	25.5	3
21	9.7	1	19.4	2
28	7.1	—	7.1	1
29	9.7	1	19.4	2
36	6.0	—	6.0	1
41	3.2	—	3.2	1
56	9.4	—	9.4	1
57	4.6	—	4.6	1
79	9.5	—	9.5	1
(Min. Total)	67.7		104.1	13

Habit. Rm #	*Area*	*Upper Stories*	*Total area w/upper stories*	*Total Units*
2	6.4	—	6.4	1
3	5.8	2	17.4	3
5	11.3	1	22.6	2
6	5.9	—	5.9	1
10	8.3	2	24.9	3
25	5.9	—	5.9	1
30	10.8	1	21.6	2
39	3.6	—	3.6	1
51	3.7	—	3.7	1
89	4.5	—	4.5	1
		Maximum Total	220.6	29

Other Functions

9	7.2	33	3.4
11	0.3	37	2.5
12	1.1	42	7.5
13	2.6	44	2.9
15	1.5	45	2.1
16	3.4	46	5.2
17	2.5	47	10.0
18	12.2	48	1.2
20	2.7	50	1.4
22	12.4	52	1.9
23	17.2	53	1.7
24	1.7	74	5.8
26	3.4	81	1.6
27	2.5	Kv A	14.4
31	5.3		140.6
32	3.0		

$$\text{MIN}\ \frac{67.7 + 140.6}{10} = 20.8$$

$$\text{MAX}\ \frac{220.6 + 140.6}{10} = 36.1$$

Chapter 8

Pollen Analysis of Floor Sediment Samples:

A Guide to Room Use

In the past, many archeologists overlooked the valuable information to be derived from recovery and analysis of fossil pollen in archeological sites. This was not true at Antelope House, where archeologists collected more than 950 sediment samples. More than one-third of these have been processed and analyzed (see also Chapter 25).

Before excavation, we hoped that at least two types of information could be derived from the analysis of pollen: (1) we hoped that fossil pollen could be used as one tool in determining the functions of many of the ceramic vessels and grinding implements; (2) we hoped that fossil pollen recovered from floor surfaces would be of use in determining room function. Bryant and Morris (Chapter 25) demonstrate that certain grinding stones probably were used for turning maize into flour and that many of the black, widemouth, corrugated vessels were used as cooking and food storage containers. This chapter deals with the second phase of the pollen study.

Sample Collection, Extraction and Analysis

As pointed out by Bryant and Morris (Chapter 25), the collection, processing and storage of many types of wild and cultivated plants may result in the dispersion of pollen from harvested plants brought into rooms. Most of that pollen would eventually settle in the room floors, where it would remain until later recovered by carefully scraping the floor surfaces.

During excavation, soil sediment samples were routinely collected by individuals trained in proper pollen sampling techniques. Whenever possible, samples containing about .25 kg of sediment were carefully removed with a clean trowel and placed in sterile plastic bags, which were immediately sealed and labeled. Care was taken during the collection of each sample to avoid contamination by modern pollen from atmospheric sources. Field notes were later cross-checked against the label on each pollen sample to insure accuracy and completeness of data.

One hundred fifty of the pollen samples used in our study were processed at the University of Arizona Palynology Laboratory by Dr. Gerald Kelso, using chemical extraction techniques designed for Southwestern U.S. soils. An

additional 60 soil samples later were processed by the Texas A&M University Palynology Laboratory. Similar chemical extraction techniques were used to insure that the data were compatible for interpretation. Pollen extraction, described in Chapter 25, was based on standard procedures outlined by Gray (1965).

Once extracted, the pollen was stained, dehydrated, mixed with small amounts of silicon oil and mounted for microscopic analysis. All identifiable whole pollen grains were counted, as was each recognizable pollen grain fragment. Pollen grains which were badly crushed or deteriorated beyond recognition were excluded, as were cryptogamic spores (ferns, mosses and fungi). Pollen grains which were well preserved but not positively identified were included in the counts as unknowns. All information in this chapter is based on pollen counts of at least 200 to 300 grains per sample, as suggested by Barkley (1934) and Martin (1963).

Identification of pollen types was made by morphological comparison with modern pollen reference material stored at the University of Arizona and Texas A&M University palynology laboratories. *Ephedra* pollen was divided into two groups (*Ephedra nevadensis* and *E. torreyana* types), based on morphological differences. More than 90 percent of all *Ephedra* pollen recovered from Antelope House samples was of the *E. nevadensis* type.

Compositae pollen was divided into four groups, based on morphological differences. High-spine and low-spine composite pollen types were separated on the basis of surface spine length, while *Artemisia* was distinguished by its distinctive mesocopial wall morphology. Liguliflorae-type composite grains were easily recognized by their fenestrate surface morphology.

The term Cheno-Am (Martin 1963) is used in this report to include pollen grains of the family Chenopodiaceae and the genus *Amaranthus*, since their similar pollen wall morphology makes it difficult to distinguish one type from another using only the light microscope.

Pollen counts of all samples processed at the University of Arizona were made by Kelso; all samples processed and analyzed at Texas A&M University were counted by us. Although we did not examine any of the pollen samples counted by Kelso, his pollen counts appear to be consistent with our results in most cases.

Some of the 210 pollen samples examined did not contain sufficient fossil pollen to provide a statistically valid count. Some contained large quantities of charcoal, which prevented concentrating the pollen residue for analysis, and some of the samples processed and examined by Kelso were not collected from suitable proveniences and thus did not pertain to our study. All pollen samples pertinent to our research design are included in this report, regardless of our preconceptions concerning the suspected pollen contents of floor surfaces.

Many of the pollen samples were collected directly above, on or below actual floor surfaces. With this degree of control, we were able to determine the probability that the fossil pollen contents of floor surfaces represented human occupation and activities, rather than pollen from pre-floor matrix or post-occupation debris.

The combined pollen data are presented in Tables 15, 16 and 17. In these tables, we have included only a limited number of the more important pollen types which occur with regularity throughout the samples. In all, more than 60 pollen types were identified in this study; precise counts for each sample are on file at the Western Archeological Center.

Fossil Pollen as a Guide to Room Use

Using fossil pollen data as a guide to room use is not entirely new. Hevly (1964) used the technique for a limited number of rooms at the Broken K Pueblo in central Arizona. He later expanded his study to include a larger number of rooms (Hill and Hevly 1968). In both cases, Hevly used the percentages of fossil economic pollen as the basis for assigning probable room use in one of three main categories: storage, habitation or ceremonial. Hevly concluded that rooms associated with general habitation use should contain an average of less than 22 percent economic pollen, whereas rooms associated with a storage function should contain more than 22 percent. He concluded that the fossil pollen yield from ceremonial rooms should be similar to the pollen yield from habitation rooms, although ceremonial rooms tended to yield higher percentages of *Ephedra* and *Eriogonum* pollen.

Table 15. Major fossil pollen types recovered from probable storage units. All figures listed represent percentages of total pollen recovered from each sample.

Pollen Sample	Provenience	*Zea*	*Clemoe*	*Typha*	*Physalis*	*Cucurbita*	*Eriogonum*	*Opuntia*	*Pinus*	*Juniperus*	*Quercus*	*Salix*	*Artemisia*	*Cheno-Am*	*Ephedra*	*Gramineae*
788	Room 1 Above Floor 3	6	23	5	2	1	—	1	22.5	7	1	4.5	2	6	0.5	5.5
795	Room 1 Floor 3 surface	13	29	5	2	1	—	—	13.5	4	2	7.5	1.5	11	0.5	3
796	Room 1 Below Floor 3	2	4	—	—	—	1	—	38.5	14	1	0.5	3	17	2	1
859	Room 1 Above Floor 6	6.5	1	0.5	—	—	—	0.5	55	5	3	0.5	3	4	6	2
860	Room 1 Floor 6 surface	25	1	2	—	1	0.5	1.5	32.5	3	3.5	2	2	9	2	0.5
874	Room 1 Floor 6 surface	2.5	1	—	—	—	—	—	59.5	—	8	1	2	11.5	—	2
878	Room 1 Below Floor 6	27	1	9	—	0.5	0.5	2.5	21.5	2	1	4	1.5	3.5	0.5	9
605	Room 8 Above Floor 1	59.5	6.5	—	—	—	—	1	25	1	0.5	1	0.5	1.5	0.5	1
606	Room 8 Floor 1 surface	33	17.5	1	—	0.5	0.5	1	21	2	1	2	1	8	0.5	2
39	Room 9 Above Floor 1	16	22.5	—	7	—	—	—	18	5	1	2	6.5	10.5	0.5	—
18	Room 9 Floor 1 surface	0.5	1.5	1	—	—	0.5	—	52.5	13.5	2	—	0.5	16	1.5	2.5
62	Room 9 Below Floor 1	0.5	1.5	1	—	—	—	—	60	11	0.5	0.5	2	10	1	1.5
526	Room 15 Above Floor 1	1.5	4	1.5	0.5	—	1	—	23.5	2	2.5	2.5	4	12.5	2	3
527	Room 15 Floor 1 surface	8	2.5	—	—	—	—	—	23	6	1	2	18	22	1	1
180	Room 16 Floor 1 surface	8	24.5	0.5	0.5	0.5	—	0.5	23.5	6	2	5	4	13	1	2
197	Room 16 Floor (pit) surface	15.5	6	1	1	—	—	—	33	8	0.5	1.5	2	8	—	5.5
213	Room 21 Above Floor 3	1.5	4	1	—	—	—	—	42	11	3	—	3	15.5	1	3
214	Room 21 Floor 3 surface	31	2.5	0.5	—	—	—	—	41	4	1	0.5	3	9	0.5	1.5
308	Room 21 Below Floor 3	30	1.5	1	1.5	—	—	—	35	5	1	1	1.5	7.5	3.5	2.5
320	Room 21 Above Floor 4	26.5	13	—	1	—	—	—	14	3.5	2	3	5.5	16	1	4
365	Room 21 Floor 4 surface	26	10	0.5	1	0.5	—	1	19	5	1	0.5	2	16	2	4.5
530	Room 25 Above Floor 1	31.5	4	1	6.5	1	—	0.5	8.5	6	0.5	1.5	14.5	8	3	1
531	Room 25 Floor 1 surface	0.5	15	7	1	—	—	—	21	7	2.5	2	1.5	20	0.5	2.5
848	Room 26 Floor 1 surface	0.5	2	20	—	—	—	—	42	5	1.5	0.5	1	15	0.5	1.5
536	Room 32 Above Floor 1	5	1.5	1	1	—	1	—	31	11	1	1	16.5	15	1	1.5
537	Room 32 Floor 1 surface	2	16	3	1	—	1	—	20.5	13.5	3	5	4.5	10	0.5	3
523	Room 33 Above Floor 1	4.5	1.5	3.5	3	—	0.5	—	25.5	3	2.5	3	17.5	14.5	—	1.5

continued

Table 15. Major fossil pollen types recovered from probable storage units. All figures listed represent percentages of total pollen recovered from each sample—Continued

Pollen Sample	Provenience	Zea	Clemoe	Typha	Physalis	Cucurbita	Eriogonum	Opuntia	Pinus	Juniperus	Quercus	Salix	Artemisia	Cheno-Am	Ephedra	Gramineae
524	Room 33															
	Floor 1 surface	3	6	1	0.5	—	—	—	29	12	3	2	6	14	—	6
533	Room 40															
	Above Floor 1	1.5	0.5	3.5	—	—	1	—	42.5	11	1	1.5	7	12.5	1.5	2
534	Room 40															
	Floor 1 surface	2.5	5	5	—	—	—	—	36.5	11.5	2	2	4.5	14	1	3
300	Room 44															
	Floor 1 surface	43	2.5	1	0.5	0.5	—	1	16	2	1	10.5	4	7	0.5	2.5
309	Room 45															
	Floor 1 surface	3	4.5	24	—	—	—	—	28.5	8.5	6.5	1	1.5	11.5	1	3
330	Room 50															
	Floor 1 surface	1	1.5	5	—	1.5	—	—	51.5	10	1.5	1	1.5	15.5	1.5	2.5
623	Room 68															
	Floor 1 surface	16	13.5	0.5	—	0.5	—	—	26	13	2	3	3.5	7	1	2
678	Room 72															
	Floor 1 surface	30	2.5	4	—	—	—	2	45.5	3	1	—	0.5	2	1	3

Table 16. Major fossil pollen types recovered from probable habitation units. All figures listed represent percentages of total pollen recovered from each sample.

Pollen Sample	Provenience	Zea	Clemoe	Typha	Physalis	Cucurbita	Eriogonum	Opuntia	Pinus	Juniperus	Quercus	Salix	Artemisia	Cheno-Am	Ephedra	Gramineae
827	Room 1															
	Above Floor 4	9	18	—	1	0.5	—	0.5	21	7	1	4	2	14	0.5	8
836	Room 1															
	Floor 4 surface	12	13.5	1	—	—	—	—	31.5	10.5	1	2.5	1	8.5	1	7
829	Room 1															
	Below Floor 4	2	8.5	—	—	—	—	—	50	14	—	1	2	13	1	1
850	Room 1															
	Above Floor 5	3	16	0.5	—	—	—	—	14	7	8	31	2	7	1	3
851	Room 1															
	Floor 5 surface	7	16	—	—	—	—	—	21	8	1.5	5.5	3.5	8	1	13
852	Room 1															
	Below Floor 5	1	—	0.5	—	—	—	1	64	8	1	—	1	11	1.5	2.5
871	Room 1															
	Floor 5A surface	4	9	—	—	—	0.5	0.5	36	11	2	0.5	2	18	1	—
853	Room 1															
	Below Floor 5A	—	—	—	—	—	—	—	46	—	2	—	—	6	—	2
568	Room 2															
	Above Floor 2	2	4.5	54.5	—	—	—	—	15.5	0.5	0.5	3.5	6.5	7.5	0.5	—
569	Room 2															
	Floor 2 surface	2	5.5	9	—	—	—	—	36	17	—	0.5	4	12.5	1	1.5

continued

Table 16. Major fossil pollen types recovered from probable habitation units. All figures listed represent percentages of total pollen recovered from each sample—Continued

Pollen Sample	Provenience	Zea	Clemoe	Typha	Physalis	Cucurbita	Eriogonum	Opuntia	Pinus	Juniperus	Quercus	Salix	Artemisia	Cheno-Am	Ephedra	Gramineae
574	Room 2 Below Floor 2	4	10	10	2.5	—	—	—	16	7.5	4	2.5	5.5	19.5	1.5	2
587	Room 2 Above Floor 4	17	28.5	5	0.5	—	—	0.5	15	6	1.5	5	3.5	6	1	1
590	Room 2 Floor 4 surface	3	10	3.5	—	—	0.5	—	46	9.5	2	0.5	3	8.5	0.5	2
591	Room 2 Below Floor 4	2.5	3	7	—	—	—	—	45	16.5	1.5	0.5	1	12	0.5	6.5
592	Room 2 Floor 6 surface	3	5.5	—	—	—	—	—	46	9	2	1	2	12	1	5
225	Room 6 Floor 1 surface	2	1	—	—	—	—	0.5	56	6	6	1	4	12	1	2
339	Room 6 Above Floor 2	11.5	3.5	—	3.5	—	—	1	22.5	7.5	3.5	1.5	6	22.5	—	2.5
337	Room 6 Floor 2 surface	8.5	7	—	0.5	—	—	—	37	8.5	4	1	2.5	16	1	1.5
124	Room 28 Floor 2 surface	2	2	4	—	—	—	0.5	61.5	4	1	0.5	2.5	11	1.5	2
125	Room 28 Floor 3 surface	2	4.5	4	—	—	—	—	52.5	9	3	0.5	2	8.5	—	5
841	Room 29 Above Floor 4	28	16	8	1.5	—	—	—	13	5.5	1.5	0.5	8.5	7	2	—
840	Room 29 SW Floor 4 surface	8	21	—	—	—	—	—	21	4	4	3	—	8	14	4.5
842	Room 29 SE Floor 4 surface	18	'	1	—	1	—	0.5	20	5	3.5	2	11	13	1.5	2.5
865	Room 29 Floor 5 surface	20.5	23	0.5	17	0.5	—	0.5	4.5	3	—	8	3	10.5	—	2.5
896	Room 29 Floor 6 surface	15.5	21	—	0.5	—	—	—	18	8.5	0.5	1	3	14.5	1	4
153	Room 35 Above Floor 1	21	6.5	3	0.5	1	—	1	23	7	2	1.5	8.5	12	2.5	2
152	Room 35 Floor 1 surface	13	2	3	—	—	0.5	—	56	5.5	1	1.5	4	7	—	1
173	Room 35 Above Floor 2	8	14.5	—	—	—	—	—	13.5	8	1.5	8.5	5.5	19	2	4
172	Room 35 Floor 2 surface	0.5	20	1.5	—	0.5	—	—	31.5	12.5	0.5	0.5	4	11	0.5	3
115	Room 36 Floor 1 surface	—	5.5	0.5	—	—	—	—	24	7.5	6.5	0.5	4	28	2.5	4
419	Room 36 Above Floor 2	24.5	9	12.5	—	—	0.5	—	9	6	0.5	3	2.5	12.5	2	7
420	Room 36 Floor 2 surface	26	11	13	—	—	—	—	6.5	4	1	4	2	14	1	8
129	Room 38 Floor 1 surface	2	5	4	—	—	—	—	62	4	—	—	2.5	14	0.5	1
317	Room 46 Floor 1 surface	13	19.5	2	0.5	—	0.5	—	27.5	7	1	1	1.5	8.5	0.5	6
588	Room 57 Floor 1 surface	2	3	6.5	1	—	—	—	24	19	1	6	5	16	1.5	3
619	Room 67 Floor 1 surface	25.5	20	1	2	0.5	1	—	16.5	4.5	1	3	6	5.5	1	1

Table 17. Major fossil pollen types recovered from probable ceremonial units. All figures listed represent percentages of total pollen recovered from each sample.

Pollen Sample	Provenience	*Zea*	*Clemoe*	*Typha*	*Physalis*	*Cucurbita*	*Eriogonum*	*Opuntia*	*Pinus*	*Juniperus*	*Quercus*	*Salix*	*Artemisia*	*Cheno-Am*	*Ephedra*	*Gramineae*
222	Room 18 Floor 1 surface	5	4.5	34.5	—	—	—	—	28.5	4	3	0.5	5	7	—	1.5
395	Room 18 Floor 1 surface	6.5	6.5	2.5	2	—	—	—	21.5	11	—	3.5	5.5	14.5	5	4
396	Room 18 Floor 1 surface	7	5	3	1	—	1	—	22.6	11	6.5	2	11	11.5	2.5	3
873	Room 23 Above Floor 1	18	2	4.5	1.5	2	1	—	22	7.5	3.5	—	4	16	1.5	3.5
868	Room 23 Floor 1 surface	0.5	4	—	—	—	0.5	—	45.5	16	2	—	3	15	1	1.5
877	Room 23 Below Floor 1	—	1.5	1.5	—	—	—	—	64.5	10.5	2.5	—	1	9	2	2.5
335	Room 42 Above Floor 1	11	3	7.5	1	—	—	—	37.5	6	2	1.5	7.5	12	—	2
326	Room 42 Floor 1 surface	2	3.5	13	—	—	—	—	49.5	5	2	0.5	2	11	—	0.5
706	Room 47 Floor 1 surface	2	3	10.5	—	—	—	—	50	10.5	4	0.5	2.5	16	3.5	—
187	Room Kiva-B Above Floor 2	19	9	1	1	—	—	0.5	13.5	4	1	1	5	8	—	22
188	Room Kiva-B Floor 2 surface	8	11.5	1	—	—	—	—	21.5	13	2	—	7.5	12	1.5	6.5
184	Room Kiva-B Floor 2 above	16	10.5	6	—	—	—	—	19.5	8.5	0.5	1	2.5	7	—	14
185	Room Kiva-B Floor 2 surface	7	7.5	0.5	—	—	0.5	—	21	13.5	2.5	2	6	14.5	—	8.5
629	Room Kiva-D Floor 1 surface	10	—	0.5	—	—	—	—	62.5	5	1	—	2	8	1	0.5

Hevly's work at Broken K Pueblo was a useful example of how fossil pollen data can aid archeologists in assigning a probable function to rooms associated with pueblo structures. His study has served, in part, as a model for interpretation of fossil pollen recovered from floor surfaces at Antelope House.

Morris (Chapter 7) has assigned a tentative function to rooms and other structures at Antelope House, based primarily on the structural features associated with each room and the artifacts each contained. In most cases, the pollen data correspond remarkably well to his findings. In a few cases, the fossil pollen data do not support his conclusions, although they do not necessarily reject those conclusions.

Using this sort of data to interpret probable room function is a complicated task. It involves a certain amount of deductive reasoning and inference from sometimes incomplete data. With this in mind, we shall try to explain the reasoning behind our conclusions.

At Broken K Pueblo, Hevly (Hill and Hevly 1968) defined storage rooms as areas where food products such as corn and squash were stored, although they could also be used to store other items. He felt that most, but not all, storage areas should yield a fossil pollen record with high percentages of economic pollen. Economic pollen, as he defined it, includes mostly insect-pollinated types, such as *Cleome* (beeweed), *Cucurbita* (squash), *Opuntia* (cactus), *Sphaeralcea* (Globe-

mallow) and *Oenothera* (evening primrose), as well as several wind-pollinated types, such as *Zea* (maize), *Typha* (cattail) and the *Cyperaceae* (sedges).

After carefully examining the archeological and fossil pollen data from Antelope House, we concluded that of the ancient floor surfaces most of the probable storage structures contained at least 25 percent fossil economic pollen. Although we recognize that the inhabitants of Antelope House ate a wide range of cultivated and wild plants, based upon the human coprolite data (Chapter 14), we decided to limit our economic pollen category to three of the more commonly used plants, since we believe these to be the strongest markers for determining room use. These are *Zea*, which was cultivated; *Typha*, which was not cultivated; and *Cleome*, which was probably not cultivated but which may have been encouraged to grow in and around agricultural fields, as has been found in the Hovenweep National Monument area (Weir 1976).

Storage Rooms

Archeologists excavating Antelope House categorized as probable storage units those rooms considered too small for general habitation use, which lacked artifacts or features associated with habitation or which were located in areas of the site believed to have been used mainly for storage. If each of the suspected storage areas at Antelope House had been directly associated with the storage of food products, such as maize, cattails and beeweed, then our task as palynologists would have been straightforward, but some of the suspected storage areas may have been used to store non-food items.

Morris (Chapter 7) cites at least 16 rooms believed to have been used for some type of storage and for which fossil pollen data are available. The data for each of the rooms are listed in Table 15; the significance of the data is discussed below.

Room 1

This is a medium to large room with a series of identifiable floor surfaces dating to PII and EPIII.

The earliest use of this room was associated with Floor 6. The Floor 6 surface is featureless and was assigned a probable storage function on that basis. Our recovery of 28 percent economic pollen from that surface supports the conclusion. We also recovered some *Opuntia* (prickly pear cactus) pollen associated with Floor 6. Although the percentage of pollen is not high, the plant is insect-pollinated, which means that little pollen is carried by wind currents. Thus the presence of even 2.5 percent cactus pollen suggests possible economic use. Such use is well documented among modern Pueblo peoples, whose forefathers frequently harvested, stored and ate prickly pear fruit, particularly in the spring when other foods often were scarce (Whiting 1939; Swank 1932; Stevenson 1915). The economic use of prickly pear cactus at Antelope House is also documented by the coprolite data (Chapter 14).

Above Floor 6 were a series of floors thought to have been used for habitation. It wasn't until early Pueblo III times and the construction of Floor 3 that archeological evidence suggests a shift back to storage. The fossil pollen recovered from Floor 3 clearly defines it as a probable storage area, since 47 percent of the total pollen comes from three economic sources (maize, beeweed and cattail). Use of this room for habitation will be discussed below.

Room 8

This is a very small room, having a floor area of less than 1 m^2. Its small size and its featureless hard-packed clay floor suggest that it was used primarily for the storage of food products during PII. Since the fossil pollen recovered from Floor 1 contains more than 51 percent economic pollen (of which 33 percent is maize) our data support this conclusion.

Room 9

Like Room 1, this is quite large, having a floor area of nearly 8 m^2. No hearths or other features are associated with Floor 1, a surface dating from the Late Pueblo III period. The room was assigned a storage function because it lacked artifacts and features which would imply habitation. Floor 1 contained little fossil economic pollen (10 percent) and thus its use as a food storage area is uncertain. However, we did recover 18 percent *Artemisia* (sagebrush) pollen and 22 percent Cheno-Am pollen from this floor. The sagebrush pollen represents the highest level noted in any of the Antelope House rooms we examined and may indicate the economic use of this plant. For example, among the modern Hopi, the leaves of young sagebrush plants are

cooked and eaten (Whiting 1939). The Zuni used sagebrush as a beverage, as a medicine and ceremonially (Stevenson 1915). Economic use of Cheno-Am plants such as *Chenopodium* (goosefoot) and *Amaranthus* (pigweed) is also well known, especially among modern Pueblo peoples. It is also possible that Room 15 may have been used for the storage of non-food items or for activities not directly associated with food products.

Room 16

The size of Room 16 is intermediate. The lack of artifacts and other features usually associated with habitation suggests that Room 16 served as a storage area. The recovery of 33 percent economic pollen from the surface of Floor 1 indicates that food storage was probably one of the main uses of this room during the Late Pueblo III period.

Room 25

This Late Pueblo III room is large (6 m^2), but the archeological evidence did not provide a clear indication of its probable use. There were some suggestions that during Late Pueblo III times the room was remodeled and converted from a habitation area to a storage area. This interpretation is based partly upon the lack of an interior hearth associated with the surface of Floor 1. The archeologists reasoned that the lack of a hearth could be considered evidence that the room was used primarily for something other than general habitation. The fossil pollen recovered from Floor 1 contained 22 percent economic pollen, which might indicate food preparation in a habitation room. However, 20 percent Cheno-Am pollen and 6 percent *Physalis* (ground cherry) pollen also were found in this room and may indicate storage of these plants. The fossil pollen evidence from floor surfaces in Rooms 15, 29 and 36 also suggest storage of these plants.

In short, the fossil pollen contents and the archeological data both suggest that this room could have been used as a storage area.

Room 26

This single-story structure had only one floor surface with no associated features. The archeologists believed this medium-sized room (3m^2) to be a large storage area. However, except for 20 percent cattail pollen recovered in a sample taken from Floor 1, there is little pollen evidence to suggest the storage of food products. Instead, we suggest that cattails may have been stored in this room for later use in the manufacture of household goods. Room 26 also contained 42 percent pine pollen, which may reflect the economic use of pine in this room, perhaps in the extraction of pine gum. The low percentage of maize and beeweed pollen imply that these plants were not stored in Room 26 during LPIII times.

Room 32

Archeologists assigned a storage function to this area during the LPIII period on the basis of a featureless floor and the lack of artifacts associated with general habitation areas. The fossil pollen record also suggests the storage of non-food items, since economic pollen was only 21 percent.

Room 33

Room 33 may have been part of Room 32 before a wall was built to separate the larger area into two smaller rooms. Lack of easy access to Room 33 and its reduced size led to speculation that it served as a storage area during the LPIII period. The fossil pollen recovered from Floor 1, however, contained only 10 percent economic pollen, suggesting that the room was not used for general food storage. In cases such as these, we suspect that the room probably was used for non-food storage or for some other activity not associated with plant foods.

Room 40

Room 40 contained only one floor surface and it is associated with the LPIII period. Its small size and lack of features suggests that it was used for storage. Floor 1 yielded a low percentage of fossil economic pollen (12 percent), leading us to conclude that this room probably was used primarily for the storage of non-plant foods.

Room 44

This room had only one associated floor surface. It is fragmentary and an intrusive burial complicates the assignment of probable room functions. Because the room is small and otherwise featureless, it is thought to have been used for storage during the Pueblo III period. The recovery of nearly 47 percent economic pollen, 43

percent of which is maize pollen, is strong evidence that the room probably was used mainly for the storage of maize during the Pueblo III period.

Room 45

Room 45 is not large, but it contains a hearth and one smoke-blackened wall. Archeologists who excavated this room felt that the hearth actually was associated with an earlier period and that it was not used during Late Pueblo III. Floor 1 contained an unusually high amount of cattail pollen (24 percent) and a lesser amount of maize and beeweed pollen. In terms of fossil pollen contents, this room is similar to Room 26, which also yielded high percentages of cattail pollen. Perhaps neither room was a general food storage area, but instead served primarily as a storage area for cattail plants.

Room 50

The archeologist who excavated this room stated that it probably was used as a storage area. Floor 1 was composed of a badly fragmented, mostly featureless, hard-packed clay surface. Lack of window openings, absence of floor features and the small size of the room are the primary considerations in assigning it a storage function. Rooms such as this present a problem to palynologists, since they sometimes contain low amounts of economic pollen, which would suggest habitation. The archeological evidence from this room and others in the same category suggests that it could not have been used for habitation, but the fossil pollen data do not help to identify the goods that probably were stored there.

Room 68

Room 68, a small subterranean unit, is believed to have served as some type of storage area during the LPII period. The pollen recovered from Floor 1 contained 30 percent economic types, suggesting that plant food products probably were stored in the unit.

Room 72

Archeologists recovered little information from Room 72. Although it is subterranean, it lacks any floor features which might suggest use either for habitation or for ceremonial purposes. This lack of features and associated artifacts suggests that Room 72 probably was used for storage during the Pueblo II period. The recovery of more than 36 percent economic pollen, most of it maize, supports a conclusion that the room probably was associated with maize storage or processing. Since the room lacks windows and other openings (except for a small entrance in the roof), we doubt that the area was used for food processing, making storage the most logical choice.

Habitation Rooms

A probable habitation use was assigned to a number of rooms at Antelope House on the basis of recovered archeological data. If a room were fairly large and contained window and/or doorway openings, then it was considered a possible habitation area. If the room also contained a hearth or associated food preparation artifacts and floor features, such as metates, loom anchors or milling bins, then its designation as a probable habitation area was considered more certain.

For the palynologist, it is much more difficult to determine a probable habitation use than it is to identify possible food storage areas. As noted above, floor surfaces in food storage areas generally contain a great deal of fossil economic pollen. But because food preparation and food consumption areas sometimes also are associated with habitation rooms, one would expect to recover at least some of the usual pollen types associated with those activities (i.e., maize, cattails and beeweed), although those types would be expected to total less than 25 percent. Habitation areas sometimes contain small amounts of other economic pollen types from plants such as squash and cactus. Although cooking activities may account for some liberation of both kinds of economic pollen, it is not nearly as good a source for the deposition of economic pollen as are plant food processing and plant food storage. In a few instances, we found that the fossil economic pollen recovered from habitation floor surfaces exceeded 25 percent. In such cases we offer alternate explanations.

We recovered fossil pollen from floor surfaces in 11 of the rooms to which Morris has assigned a probable habitation function. The fossil pollen data for each of these rooms are listed in Table 16 and are discussed in more detail below.

Room 1

Several of the floor levels in Room 1 have been assigned a habitation use on the basis of archeological remains. Floors 4, 5 and 5a, associated with the Pueblo II period, are thought by archeologists to represent activities other than storage, a conclusion supported by the fossil pollen data. Floors 5 and 5a are comparatively low in economic pollen (23 percent and 13 percent), suggesting a habitation area. Exactly what types of habitation activities may have been associated with this room are difficult to determine from the fossil pollen record alone. The percentage is sufficiently high to suspect that the pollen may have come primarily from food products involved in cooking or food consumption. It also is possible that the economic pollen may have come from individuals who were harvesting food crops and whose clothing and bodies became covered with pollen.

Archeologists suggested that Floor 4 probably was associated with milling and grinding activities, yet the economic pollen content of that floor surface barely exceeded 25 percent and only 12 percent of that was maize, one of the primary plants associated with milling. If Floor 4 of Room 1 was associated primarily with milling activities, then we should have recovered a higher percentage of maize pollen. Since we did not, we must conclude that only a minimal amount of maize milling actually was associated with Room 1 during Pueblo II.

Room 2

Archeological information suggested that Floors 2 and 4 should be assigned a probable habitation function, a conclusion supported by the fossil pollen data. Low percentages of economic pollen (16 percent) from both floor surfaces suggest limited food preparation and consumption, but the major room use probably was not related to those activities during the Late Pueblo III period. Floor 6 also yielded a low percentage of economic pollen (8.5 percent) and probably represents a generalized habitation use.

Room 6

Room 6 contained a circular fireplace and two circular depressions east of the hearth. It is located near Kiva 47 and it was suspected that it either was related to ceremonial use or served as a habitation area. Both floors in Room 6 yielded a low percentage of economic pollen (3 percent and 15 percent), which is consistent with general habitation use. As in other cases, the 15 percent economic pollen from Floor 2 could have come from limited food preparation or consumption during occupation in LPIII times. If, as some suspect, the room was associated with a ceremonial activity, then it would be difficult to detect this in the fossil pollen record unless pollen were used in those activities. Hevly (Hill and Hevly 1968) noted a similar difficulty at the Broken K Pueblo.

Room 28

Room 28 contains several features which led archeologists to suggest a possible habitation use for Floors 2 and 3, both dating from the Late Pueblo III period. Shallow depressions in the floors were assumed to be associated with metates and grinding activities. The presence of a slab-lined hearth by the north wall also suggests habitation. Floors 2 and 3 yielded little economic pollen (8 percent and 10 percent), implying general habitation. The exceptionally low percentage of maize pollen (2 percent) casts some doubt on the importance of this room as a major food grinding area. If large amounts of maize were ground into flour in this room, we would have expected higher percentages of fossil maize pollen. We suggest that this room was used either as a general habitation area, with no major food preparation activities, or for the storage of nonfood products. Both floors also contained high percentages of fossil pine pollen (61 percent and 52 percent) and may reflect the sweeping of these floors with pine branches or the extensive use of pine wood as fuel.

Room 29

This fairly large room contained six distinct floor surfaces, several of which were associated with features often found in rooms used for general habitation. We recovered and analyzed fossil pollen for three of these floor levels and in each instance the fossil pollen record suggested heavy use for food preparation.

Floor 6 dates from the Pueblo II period and contained two milling bins. The floor surface yielded more than 15 percent maize pollen and more than 20 percent beeweed pollen. With such relatively high percentages of economic pollen in an apparent habitation area, we favor the view

that this floor surface represents a major food processing area, where maize probably was ground into flour.

Floors 5 and 4 represent later uses of this room, dating from Early Pueblo III and Pueblo III. Floor 5 contained a central hearth and Floor 4 was featureless. As did Floor 6, both of these floor surfaces proved to be comparatively rich in fossil economic pollen (44 percent and 29 percent) for a habitation area. In addition, Floor 5 yielded 17 percent *Physalis* (ground cherry) pollen, which is unusually high for an insect-pollinated plant. Floor 4 also yielded 14 percent *Ephedra* (joint fir) pollen, the highest percentage of this fossil type recovered from an Antelope House floor surface. Economic use of the ground cherry is well documented ethnographically in the Southwest among such groups as the Hopi (Whiting 1939), the Zuni (Stevenson 1915), the Tewa (Robbins *et al.* 1916) and the Western Keres (Swank 1932). Its uses ranged from employment as a famine food to eating the berries as a condiment. Its use by prehistoric pueblo groups is also documented (Bohrer 1960; Winter 1976; Weir 1976). The use of joint fir is well known among modern Pueblo peoples. The Hopi used it as a beverage and as a medicine (Whiting 1939). Other groups, such as the Tewa and Zuni, used joint fir for similar purposes. Like the ground cherry, the use of joint fir is well documented in the prehistoric records of the American Southwest (Weir 1976). We believe that it is possible that these two potential plant foods may have been utilized by the early inhabitants of Antelope House.

We conclude from the above data that if each of these floors actually were associated with habitation, then each also was connected with a great deal of food preparation or food consumption. As noted above, high economic pollen counts from floor surfaces usually are considered reliable indicators of food storage or food processing, rather than of food preparation or consumption. There are, of course, a few exceptions to this rule and this room may be such an exception.

Room 35

The two floor surfaces associated with Room 35 contained relatively low percentages of economic pollen (18 percent and 22 percent), which seems to support the archeological conclusion that this room served as a habitation area during its occupation in Pueblo III and Late Pueblo III times. The presence of *in situ* metates, the large size of the room and its location led archeologists to suggest that the room served as a general habitation area, with some food preparation. Floor 1 yielded 56 percent pine pollen and may reflect the sweeping of floor surfaces with pine branches or the extensive use of pine for fuel, which may have been rather common practices in habitation areas at Antelope House.

Room 36

Room 36 contained two floor surfaces, both associated with the Late Pueblo III period. Slab-lined hearths and loom anchors here provide strong evidence for general habitation use. Floor 2 yielded a large amount of maize pollen (26 percent), which would imply an intensive use of that surface for food preparation and/or food consumption. It would be unusual under most circumstances to recover percentages of fossil maize pollen as high as those recovered from the surface of Floor 2 unless either food storage or intense food processing were associated with that floor surface. We believe that levels of economic pollen of 5 to 15 percent generally indicate floor surfaces associated with food preparation in a habitation area, but higher levels do not automatically rule out intensive food preparation in a habitation area. Floor 1 contained much less economic pollen (10 percent), placing it well within the expected range for floor surfaces associated with food preparation and consumption in habitation areas. Floor 1 also yielded 28 percent Cheno-Am pollen, which may indicate the economic use of that plant. The Hopi eat the cooked young leaves of goosefoot and pigweed as greens (Whiting 1939), as do the Zuni (Stevenson 1915) and the Tewa (Robbins *et al.* 1916). The prehistoric use of Cheno-Am plants in the Southwest also is well documented.

Room 38

Archeological evidence recovered from Room 38 revealed several floor levels, one of which dates to Late Pueblo III. No fossil data are available on Floor 2, but adequate fossil pollen was recovered from Floor 1. Archeologists believe that the artifacts found on Floor 1 represent preparation of raw materials for cordage and basketry. The recovery of 11 percent economic pollen from Floor 1 indicates that room activities prob-

ably did not involve the use of food plants, such as cattails, maize or beeweed. The high percentage of pine pollen (62 percent) recovered from this floor surface suggests that the room may have been directly associated with activities involving pine branches, bark, gum or needles, as were Rooms 6, 28 and 35. Pine pollen is an abundant airborne type, great quantities of which could have blown into the room and settled into the surface of Floor 1, but a count as high as 62 percent would suggest more than the normal atmospheric fallout. Pine branches may have been used to sweep rooms periodically or pine gum may have been used to waterproof cordage or basketry. The use of pine gum for waterproofing is known among the Hopi (Whiting 1939).

Room 46

Archeologists were unable to determine the probable use of this room. Excavation of the floor revealed no hearths or other features clearly suggesting either a general habitation or a storage use. The surface of Floor 1, dating from Late Pueblo III, apparently was periodically damp, which also implies that it probably was not used for either purpose on a regular basis. The recovery of more than 34 percent economic pollen from the surface of Floor 1, however, does suggest a possible storage function or intensive food preparation in a habitation room. As with certain areas in contemporary dwellings, this room may have been subject to periodic dampness problems, possibly connected with seep areas from surrounding canyon walls. Weir (1976) has noted apparently similar cases associated with canyon head springs or seeps and pueblo habitations in the Hovenweep Area.

Room 57

The presence of a large rectangular hearth in the center of Floor 1 led archeologists to assign a general habitation use to this room, an interpretation supported by the fossil pollen record. The yield of less than 12 percent economic pollen could imply that some food preparation or consumption probably was associated with the room's occupation during Late Pueblo III. We doubt that this area could have served primarily as a storage area, since the percentage of fossil economic pollen was comparatively low. The 19 percent juniper pollen in Room 57 is the highest occurrence of this fossil type in floor surfaces at Antelope House. Juniper today is a much sought after firewood among the contemporary pueblo dwellers of the Southwest. Although the juniper pollen could have come solely from atmospheric sources, we suspect that at least a portion may have come from juniper branches or firewood used in this room.

Room 67

The exact size of Room 67 is not known, since erosion along the eastern edge of the site has removed part of it. A reasonable estimate would place it in the range of 9 m^2. Although no hearth was found on Floor 1, which dates from the Basketmaker II period, archeologists found a number of floor features, including a clay ridge and two logs set into the floor. Dating of materials in this room revealed that it probably was used for a period of 40 to 100 years. On the basis of associated features, archeologists believe that for much of its occupation, the room probably was used for general habitation. The surface of Floor 1 contained nearly 47 percent economic pollen, which in most cases would clearly imply food storage. The features, however, argue against such an interpretation. As with certain other suspected habitation areas, such as Rooms 29, 36 and 46, perhaps we are dealing with habitation areas which also regularly served as major food preparation or food consumption areas over long periods.

Ceremonial Rooms

Ceremonial room floors probably are the most difficult to identify consistently on the basis of the fossil pollen content. Hevly (Hevly and Hill 1968) noted a similar problem at Broken K Pueblo, where soil samples collected from ceremonial room floors contained fossil pollen types and percentages that often were similar to those recovered from habitation floors. Although Hevly collected fewer samples from ceremonial rooms than from storage and habitation rooms, we noticed that ceremonial room samples tended to contain slightly higher percentages of *Ephedra* and *Eriogonum* (wild buckwheat) pollen than did habitation or storage rooms.

We examined soil samples from floor surfaces in six Antelope House rooms believed to have served a ceremonial function, but we were unable to detect any major trends useful in singling out ceremonial floor surfaces. We did, how-

ever, find higher than usual amounts of cattail pollen, pine pollen and juniper pollen in some of those rooms. In general, the percentage of fossil pollen recovered from suspected ceremonial rooms was similar to those found on habitation floors. Percentages of fossil pollen recovered from each ceremonial floor surface are listed in Table 17 and are discussed below in more detail.

Room 18

Room 18 is the only rectangular subterranean room at Antelope House suspected of having a ceremonial function. Its only floor surface dates from Late Pueblo III. The features associated with Floor 1 are a circular hearth, a ventilation shaft and two sets of loom anchors. The archeological data indicate that this room was a kiva. Fossil pollen recovered from all surfaces associated with Floor 1 yielded relatively low percentages of maize and beeweed pollen (9 percent to 13 percent), but an unusually high percentage of cattail pollen (35 percent). Low percentages of maize and beeweed pollen suggest that this room probably was not associated with food storage, food preparation or food consumption, except on a very limited basis and perhaps in association with certain ceremonies. We suspect that small amounts of maize and beeweed pollen may periodically have been introduced into the kiva by clinging to people's clothing. The large amounts of cattail pollen cannot easily be accounted for. Perhaps it came from pollinating cattails carried into the kiva or from cattail pollen directly involved in certain ceremonies. We know from ethnographic sources that certain pollen types, including cattail and maize, were indeed collected and used for certain ceremonies (Elmore 1943; Hill 1938). Whether the inhabitants of Antelope House used cattail pollen in a similar manner is unknown, but we believe that the fossil pollen evidence from Room 18 strongly suggests this possibility. Cattail was used ceremonially by the Hopi, who associated it with water (Whiting 1939), and in similar ceremonies and for medicinal purposes by other groups in the Southwest (Stevenson 1889).

Room 23

This room is one of the largest structures associated with Antelope House during the Late Pueblo III period. Room features such as a hearth, a deflector and loom anchors led archeologists to assign it a ceremonial function. The fossil pollen recovered from the floor of this kiva was similar in some respects to that found in Room 18. The only major differences were the absence of fossil cattail pollen and the presence of 16 percent juniper pollen, which is used ceremonially today by the Hopi, Tewa and Zuni. Little can be learned from the fossil pollen content of Room 23, although the scant economic pollen recovered (4 percent) implies that no food products were stored, prepared or carried into the kiva. There is no fossil evidence to suggest that economic pollen was used ceremonial in this kiva during the Late Pueblo III period.

Room 42

This kiva dates from Late Pueblo III and, as did Room 8, yielded fossil pollen containiing an above normal quantity (13 percent) of fossil cattail pollen. Floor 1 also yielded a high percentage (50 percent) of pine pollen. These findings suggest that cattails and pine were stored in this kiva and/or that they were used in ceremonies there. Ethnographic reports (Whiting 1939; Elmore 1943; Hill 1938) indicate that in certain ceremonies, handsful of cattail pollen were thrown into the air to dust persons and articles involved in the ceremonies. It is possible that a similar ritual use may have been made of either cattail or pine pollen in this kiva.

Had this room not contained traditional kiva features, such as a deflector, and had it not been circular, we would have suggested a possible habitation function on the basis of the fossil pollen data.

Room 47

Features found in this room clearly identify it as a kiva. The fossil pollen from Floor 1 was not as clear a guide to room function, although it did contain high percentages of cattail (10 percent) and pine pollen (50 percent). This apparent correlation between certain rooms dating from the Late Pueblo III period and associated high percentages of cattail pollen may represent a widespread ceremonial use of this plant or its pollen at Antelope House.

Kiva B

Although this room lacked some of the features generally associated with kivas, it is centrally located in the site and contained two

hearths and two loom anchors. Morris (Chapter 7) states that this structure probably was used for ceremonial activities. The pollen recovered from Floor 2, dating from Late Pueblo III, contained low percentages of economic pollen (15 percent to 21 percent), suggesting that neither food products nor ceremonially introduced pollen were associated with many of the kiva activities. Once again, however, significant amounts of juniper pollen (13 percent) were found on Floor 2.

Kiva D

This room is a subterranean kiva. The floor contained a slab-lined hearth, and along the edge, was a bench covered with 14 coats of plaster. The kiva was abandoned during the Pueblo II period and it is believed that the roof was removed to provide wooden beams for other structures. The fossil pollen contents of Floor 1 revealed a low concentration of economic pollen (10 percent) and an unusually high percentage (63 percent) of pine pollen. The low percentage of economic pollen suggests that little food was stored, processed or eaten in Kiva D. The very large amount of pine pollen is unusual and may represent the use of pine branches or pine pollen in certain ceremonies. We doubt that all of the fossil pine pollen could have been atmospheric pollen blown into the kiva through the small roof opening.

Summary

Sediment samples collected above, on and below floor surfaces of rooms at Antelope House were analyzed for their fossil pollen contents. Those data were then compared with archeological data and used to assign probable function to 16 storage rooms, 11 habitation rooms and six ceremonial rooms.

Most of the 16 storage rooms yielded fossil pollen containing large amounts of economic pollen, such as maize, beeweed and cattail. We found that, in general, such floors had combined economic pollen counts in excess of 25 percent of the total pollen. Therefore, we used the 25 percent level as our indicator for probable food storage areas. A few storage areas did not contain high percentages of economic pollen, and in those instances, we suspect that the rooms probably were used to store non-food products.

Habitation areas are not generally associated with extensive food storage and thus the potential for high percentages of economic pollen is much lower. We found that for most habitation areas, the combined economic pollen counts were below 25 percent and thus could be easily separated from the storage areas on the basis of the fossil pollen record.

Ceremonial areas were more difficult to identify solely by their fossil pollen contents. In many cases, their pollen contents were atypical of both storage and habitation areas. The one identifying feature in many of the ceremonial areas was the consistent presence of three pollen types: pine, juniper and cattail. The various ethnographic and palynological reports on the ceremonial use of plants made it apparent that their use varied with specific ceremonies, the seasons of the year and even the archeological sites themselves.

It is our belief that the various room function categories should be redefined and should be based on both the fossil pollen and the archeological data. For example, it would appear useful to redefine habitation rooms as generalized habitation rooms, as sleeping areas or as habitation areas primarily associated with the preparation and consumption of food products. Perhaps storage areas should be redefined as plant storage areas or as non-plant storage areas. Perhaps ceremonial areas should also be redefined to separate those rooms having an atypical distribution of certain fossil pollen types due to probable plant use from those rooms where plants evidently were not used for ceremonial purposes.

Finally, we believe that a number of techniques and approaches are best used in combination in order to determine room function. Among the lines of evidence which one might consider for this purpose are fossil pollen data, plant macrofossil data, functional use of artifacts and vessels (based upon their pollen content), and the archeological record itself. In this way we believe that a more nearly accurate indication of room use and function can be established.

Chapter 9

A Preliminary Plant Geography of Canyon de Chelly, N.M.

The investigation reported here was designed to yield a characterization of the major vegetation and habitat types occurring within the monument, thereby providing a basis for understanding land and plant use by the ancient inhabitants of Antelope House.

We have grouped the vegetation into seven major plant resource groups: (1) Canyon Bottom Communities, (2) Talus Communities, (3) Springs, Seeps and Other Wet Places, (4) Pinyon-Juniper Continuum, (5) Low Shrub-Grassland Communities, (6) Sagebrushland Community, and (7) Canyon Rim, Cliffs and Ledges. These groups are not of equal status, as some were designated because we felt they were important resource areas for earlier inhabitants.

To our knowledge, no other intensive vegetational study has been undertaken within the monument, although a soil ± range inventory has been published for a portion of the monument (BIA 1968) and a study of the remainder is being done by the BIA. Nichol's (1952) characterization of the vegetation for the entire state of Arizona and Hanson's thesis (1924) on the vegetation of northeastern Arizona can both be related to de Chelly in a general way. Nichol's divisions for the state are: Forest 33 percent, Grassland 25 percent and Desert 42 percent, with two or three subtypes under each grouping. About 60 percent of the monument falls within his Pinyon-Juniper subtype (Forest) and about 25 percent is Canyon Bottom, a type not specifically designated by Nichol. A study by Bent and Wright (1963; Wright *et al.* 1973) is applicable to de Chelly, since it includes a discussion of the pinyon-juniper on the western flanks of the Chuska Mountains just east of the monument. Burgess (1973) is concerned primarily with mammals, but brief "locality descriptions" give excellent botanical insights. Halse (1973) offers a systematic botanical listing, with keys, information on distribution and, and uses selected plant descriptions of the 474 taxa then known from de Chelly. Our study has added 44 species to Halse's list, bringing the total to 518. About 75 percent of these taxa are perennial. Ten percent are introduced species, primarily from Eurasia.

It should be noted that agriculture has been practiced in the canyons for about 2,000 years and animal husbandry for at least 200 years. Entirely pristine vegetation (Frenkel 1970), therefore, is rare, although it does occur on the top of Wide Rock, a butte rising almost 300 m (985 ft.) from the canyon floor just east of Spider Rock.

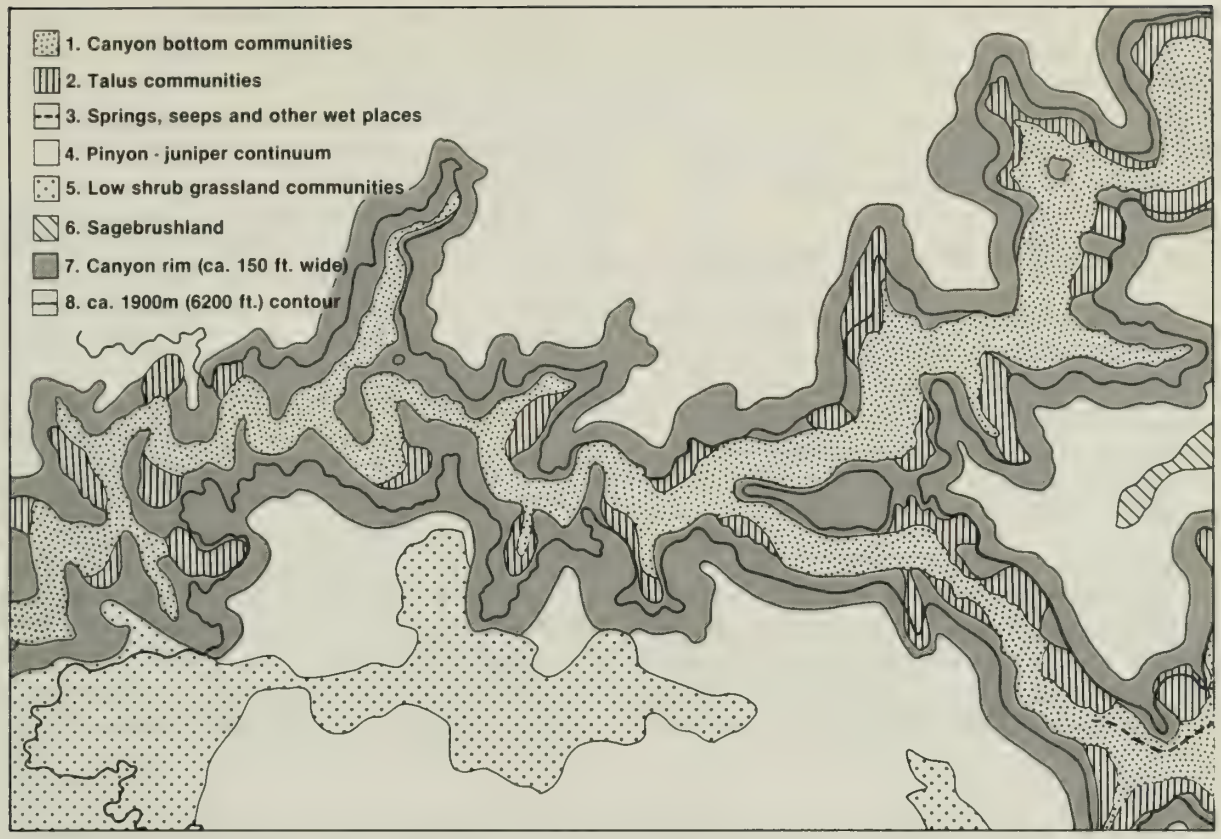


Figure 31. Distribution of seven major plant resource groups in Canyon de Chelly National Monument.

Method

Field work was done in three segments: June 9–25, 1973, Oct. 2–3, 1973; and Oct. 19–21, 1974. Although the spring of 1973 had been unusually wet, resulting in an abundant and diverse annual flora, we were forced by lack of time to ignore it; emphasis was placed on the major perennial vegetation (pinyon-juniper and associated perennial shrubs and grasses).

Quantative sampling sites were chosen as follows: (1) the north rim of del Muerto was selected because it is adjacent to Antelope House; (2) the canyon bottom was excluded because much of it is either cultivated or barren stream bed and because most of the present day streamside shrub and tree vegetation in the lower canyon was planted for channel stabilization in the 1930's, 1940's and 1960's (Brugge and Wilson n.d.); and (3) talus communities were included because they were easily accessible to the prehistoric inhabitants and because they undoubtedly were important sources of plants not otherwise found in the canyon bottom.

Aerial photos of the north rim, with square meter resolution, were available, but they covered only the spur roads leading to overlooks. Fortunately, these were adequately spaced to provide photographic coverage of three distinguishable community "subtypes," corresponding to different elevational ranges within the Pinyon-Juniper Continuum, and of the two major shrub communities observed in the monument.

Three sampling transects were run, one each in sparse, medium and dense pinyon-juniper. The quarter method of Cottam and Curtis (1956) was used to determine relative dominance and relative density. Relative frequency and importance value were determined using the methods of Curtis and McIntosh (1950, 1951). Cover was determined from line intercept, except for the sparse pinyon-juniper, in which the method described by Cooper (1957) was used.

Visual comparisons were made with similar sites along the South Rim Drive. Two relatively

undisturbed areas, the ledges of the north side of Navajo Fortress, situated between Antelope House and Standing Cow Ruin in Canyon del Muerto, and the pristine rim vegetation of Wide Rock Butte, situated at the junction of de Chelly, Monument and Bat Canyons, were observed.

The Plant Resource Communities

The composition and characteristics of each of our seven plant resource groups are discussed in detail below and summarized in Table 18. Appendix E lists in alphabetical order the common names of the plants cited in our discussion, as well as those plants known by more than one scientific name.

1. Canyon Bottom Communities

The canyon bottoms, which total about 100 km² (25,000 acres), can be divided into at least two regions: lower and upper. The lower region (including about 16 km² or 3,950 acres) is that generally below 1,830 m (6000 feet). It includes low terraces with very sandy soil and a broad sandy streambed containing almost no vegetation. Except in areas of bare rock, the upper region is vegetated throughout. Especially in the canyon heads, the boundaries between (1) Canyon Bottom Communities, (2) Talus Communities, (3) Seeps, Springs and Wet Places and (7) Canyon Rim, Cliffs and Ledges are somewhat obscure. In these locations, the vegetation constitutes a continuum. A wide variety of plant species is found in the Canyon Bottom Communities (Table 19).

The dominant trees of the lower canyon today are *Elaeagnus angustifolia, Tamarix ramosissima, Populus wislizenii* and *Salix amygdaloides*. The Russian olive (*E. angustifolia*), introduced from Eurasia, was planted in the canyon in 1964. A few plants have now spread into the upper parts of Canyon del Muerto, about 13 km (8 miles) above Mummy Cave. Cottonwoods (*Populus* sp.) and willows (*Salix* sp.) were present prior to 1934, but others were planted, as was tamarisk (*Tamarix ramosissima*, imported from Eurasia),

Table 18. Major plant resource groups, with approximate areas (km², acres, percent of total) and elevational extent within monument boundaries. (Any plant species may occur in more than one group.)

Plant Resource Group		*Ca. Area in Monument*	*Ca. Range in Elevation*	*Ca. Number of Plant Species*
1	Canyon Bottom Communities	100 km² (25,000 acres) 24%	1700–2210 m (5530–7200 ft) but ⅔ is below 1900 m (6200 ft)	267
2	Talus Communities	5 km² (1200 acres) 1%	Scattered and above the same range as above	83
3	Springs, Seeps and Other Wet Places	Not more than 1 or 2 km² (240–490 acres) 0.5%	Scattered throughout the canyon system	62
4	Pinyon-Juniper Continuum	Sparse 32 km² (7900 acres) 9%	1900–2000 m (6200–6600 ft)	63
		Medium and Dense 164 km² (40,000 acres) 48%	2000 m to above the monument limits at 2300 m (7600 ft)	
5	Low Shrub-Grassland Communities	18 km² (4400 acres)	Lower monument limits to 1900 m (6200 ft)	78
6	Sagebrush-land Community	31 km² (7600 acres) 9%	Scattered but mostly above 2000 m (6600 ft)	14
7	Canyon Rim, Cliffs and Ledges	3–4 km² (2250–2500 acres) 3%	Variable from 1700–2300 m (5600–7600 ft)	245

Table 19. Alphabetical list of 115 selected species (all but 3 are perennial), with relative abundance in plant resource group and sample area. Species preceded by asterisk were introduced.

Selected Species	*Plant resource group and sample area*															*Habit*
	1		2			3		4			5		6	7			
	A	B	A	B	C	A	B	A	B	C	A	B		A	B	C	
Acer negundo	c	c	-	-	i	c	i	-	i	-	-	-	-	-	c	-	TR
Adiantum capillus-veneris	-	-	-	-	-	-	c	-	-	-	-	-	-	-	-	-	PH
**Agrostis alba*	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
**A. semiverticillata*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
Alnus oblongifolia	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	TR
Alopecurus aequalis	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	PH
Amelanchier utahensis	-	-	-	r	c	-	-	-	r	-	-	-	-	r	c	r	SH, TR
Andropogon scoparius	r	-	-	-	-	-	i	-	-	-	-	-	-	-	-	i	PH
Anemopsis californica	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
Aquilegia micrantha	-	-	-	-	-	-	i	-	-	-	-	-	-	-	i	-	PH
Aristida fendleriana	r	-	-	-	-	-	-	-	-	-	-	-	-	c	i	c	PH
A. longiseta	c	-	-	-	-	-	-	-	-	-	-	-	-	c	i	c	PH
Artemisia bigelovii	r	-	-	-	-	-	-	-	-	-	-	-	-	i	c	c	SS, SH
A. frigida	-	-	-	-	-	-	-	-	-	i	-	-	-	-	c	-	SS
A. tridentata	i	i	-	-	i	-	-	-	c	i	-	-	c	i	i	r	SS, SH
Aster hirtifolius	-	-	-	-	-	-	-	i	-	-	c	c	-	c	i	i	SS
Atriplex canescens	c	-	i	i	-	-	-	r	-	-	-	-	-	r	-	-	SS, SH
Berberis repens	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SS
Betula occidentalis	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	TR
Bouteloua curtipendula	c	-	i	-	-	-	-	-	-	-	-	-	-	c	i	c	PH
B. gracilis	c	r	-	i	-	-	-	-	-	i	-	-	-	c	r	c	PH
Brickellia grandiflora	c	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SS, SH
B. scabra	-	-	-	c	-	-	-	-	-	-	-	-	-	c	-	-	SS
Celtis reticulata	c	-	i	-	-	-	-	-	-	-	-	-	-	-	-	-	TR
Cercocarpus intricatus	i	-	c	-	-	-	-	-	-	-	-	-	-	c	i	c	SH
C. montanus	i	-	-	-	-	-	-	-	-	-	-	-	-	c	i	-	SH
Chrysopsis villosa	c	-	c	c	-	-	-	-	-	-	-	-	-	c	c	-	SS
Chrysothamnus nauseosus	c	-	-	-	-	-	-	c	-	-	c	c	-	c	i	i	SS, SH
Clematis ligusticifolia	i	-	-	-	-	-	i	-	-	-	-	-	-	i	i	-	VI
Cornus stolonifera	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	SH
Coryphantha vivipara	-	-	-	-	-	-	-	-	-	i	-	-	-	-	-	-	SU
Cowania mexicana	r	-	i	-	-	-	-	-	c	i	-	-	-	c	-	-	SH
**Cynodon dactylon*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
Cystopteris fragilis	-	-	-	-	-	c	i	-	-	-	-	-	-	-	r	-	PH
Echinocereus fendleri	-	-	r	-	-	-	-	-	-	-	-	-	-	r	-	-	SU
E. triglochidiatus	c	-	-	-	-	-	-	-	-	-	-	-	-	c	-	c	SU
**Elaeagnus angustifolia*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	TR
Elymus elymoides	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	c	PH
Ephedra viridis	c	-	-	i	-	-	-	c	i	-	c	i	-	c	c	c	SS, SH
Equisetum arvense	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	PH
E. hymale (E. hiemale)	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
E. laevigatum	c	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PH
Eriogonum alatum	-	-	-	-	-	-	-	-	-	-	-	-	-	c	r	-	PH
E. simpsoni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	i	c	SS
Fendlera rupicola	-	-	i	c	c	-	-	-	i	-	-	-	-	i	c	-	SH
**Festuca elatior*	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	PH
Glyceria striata	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-	PH
Gutierrezia sarothrae	c	-	-	-	-	-	-	c	c	-	c	i	-	c	c	c	SS, SH

continued

Table 19. Alphabetical list of 115 selected species (all but 3 are perennial), with relative abundance in plant resource group and sample area. Species preceded by asterisk were introduced—Continued

Selected Species	*Plant resource group and sample area*																			*Habit*
	1		2			3		4			5		6	7						
	A	B	A	B	C	A	B	A	B	C	A	B		A	B	C				
Haplopappus armerioides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	c				SS
Hilaria jamesii	-	-	-	i	-	-	-	c	-	-	c	-	-	c	-	c				PH
Holodiscus dumosus	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				SH
Horedeum jubatum	i	c	-	i	-	c	-	-	-	c	-	-	c	-	-	-				PH
Hymenoxys richardsonii	-	-	-	-	-	-	-	-	-	c	-	-	-	-	-	-				PH
Juglans major	i	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-				TR
Juncus balticus	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
J. bufonius	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				AN
Juniperus osteosperma	c	i	c	c	c	-	-	c	c	c	i	-	c	c	c	c				TR
J. scopulorum	-	c	-	-	-	-	-	-	-	i	-	-	r	-	c	-				TR
Koeleria cristata	-	-	-	-	-	-	-	-	-	c	-	-	-	-	c	c				PH
Lycium pallidum	i	-	i	-	-	-	-	-	-	-	i	-	-	-	-	-				SS, SH
Lycurus phleoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	c				PH
**Malus sylvestris*	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				TR
Muhlenbergia montana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	c				PH
M. pauciflora	-	-	-	-	-	-	i	-	-	-	-	-	-	-	-	c				PH
M. pungens	-	-	-	-	-	-	-	-	-	-	-	-	-	c	-	-				PH
M. racemosa	-	i	-	-	-	-	i	-	-	-	-	-	-	-	-	r				PH
Nolina microcarpa	-	-	-	i	-	-	-	-	-	-	-	-	-	-	-	-				PH, SH
Opuntia erinacea	c	-	-	i	-	-	-	c	i	i	c	-	-	c	c	c				SU
O. phaeacantha	c	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-				SU
O. whipplei	c	-	i	-	-	-	-	i	i	-	-	-	-	i	i	i				SU
Oryzopsis hymenoides	c	-	c	c	i	-	-	c	i	-	c	-	-	c	-	c				PH
Parthenocisus inserta	i	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-				VI
Philadephus microphyllus	i	-	i	i	c	-	-	-	-	-	-	-	-	-	c	-				SH
Phragmites communis	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Pinus edulis	-	-	-	c	i	-	-	c	c	c	r	-	r	c	c	c				TR
P. ponderosa	-	c	-	-	i	-	-	-	-	i	-	-	r	-	i	r				TR
**Poa compressa*	c	c	-	i	-	c	c	-	-	-	-	-	-	-	-	-				PH
P. fendleriana	-	-	-	-	c	c	c	-	-	-	-	-	-	c	c	c				PH
**Populus wislizenii*	c	-	i	-	-	-	i	-	-	-	-	-	-	-	-	-				TR
**Prunus persica*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				TR
P. virginiana	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				TR
Pseudotsuga menziesii	-	c	-	-	c	i	-	-	-	-	-	-	-	-	c	r				TR
Quercus gambelii	i	c	-	-	c	r	-	-	-	i	-	-	-	r	c	r				TR
Q. turbinella	c	-	c	c	-	-	-	-	-	-	-	-	-	c	-	r				SH, TR
Ranunculus aquatilis	-	-	-	-	-	c	-	-	-	-	-	-	-	-	-	-				PH
R. cymbalaria	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				AN
R. macounii	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
Rhus radicans	c	i	-	-	-	-	-	-	-	-	-	-	-	i	i	-				SS, SH
R. trilobata	-	-	-	-	c	-	-	-	-	-	-	-	-	c	c	-				
Rubus strigosus	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
**Salix amygdaloides*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				TR
S. exigua	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				SH, TR
Sarcobatus vermiculatus	i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				SH
Scirpus americanus	c	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-				PH
S. microcarpus	-	c	-	-	-	c	-	-	-	-	-	-	-	-	-	-				PH

continued

Table 19. Alphabetical list of 115 selected species (all but 3 are perennial), with relative abundance in plant resource group and sample area. Species preceded by asterisk were introduced—Continued

Selected Species	*Plant resource group and sample area*																			*Habit*
	1		2			3		4			5		6	7						
	A	B	A	B	C	A	B	A	B	C	A	B		A	B	C				
Selaginella mutica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	c	i				PH
Sisyrinchium demissum	c	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
Smilacina racemosa	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
Solidago graminea	-	-	-	-	-	-	-	-	-	-	-	-	-	c	-	c				PH, SS
Sphenopholis obtusata	-	-	-	-	-	-	i	-	-	-	-	-	-	-	-	-				PH
Sporobolus airoides	i	-	-	-	-	-	-	-	-	-	-	-	-	c	-	i				PH
S. cryptandrus	-	-	-	-	-	-	-	-	-	-	-	-	-	c	-	r				PH
Stephanomeria tenuifolia	-	-	c	c	-	-	-	-	i	-	-	-	-	c	-	i				PH, SS
Stipa comata	-	-	c	i	-	-	-	c	i	i	i	-	c	i	-	c				PH
S. speciosa	-	-	i	-	-	-	-	-	-	-	-	-	-	c	-	i				PH
Symphoricarpos oerophilus	-	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				SH
**Tamarix ramosissima*	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				SH
Typha latifolia	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
Urtica gracilis	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				PH
Veronica americana	c	c	-	-	-	c	c	-	-	-	-	-	-	-	-	-				PH
V. anagallis-aquatica	c	c	-	-	-	c	c	-	-	-	-	-	-	-	-	-				PH
V. peregrina	r	-	-	-	-	-	c	-	-	-	-	-	-	-	-	-				AN
Vitis arizonica	c	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				VI
Yucca angustissima	c	-	c	-	-	-	-	c	c	-	-	-	-	c	-	r				SU
Y. baccata	c	-	-	c	-	-	-	-	c	-	-	-	-	c	r	c				SU

Key to Symbols

1 = Canyon Bottom Communities
- A = lower canyon bottoms
- B = upper canyon bottoms as seen in Upper Del Muerto and/or monument

2 = Talus Communities
- A = rockfall talus near Refuge Rock, lower elevation; south-facing
- B = rubble talus near Face Rock, higher elevation; south-facing
- C = northfacing

3 = Springs, Seeps and Other Wet Places
- A = streamside, as in Upper Del Muerto
- B = others; scattered, usually smaller in extent

4 = Pinyon-Juniper Continuum
- A = sparse, Ledge Ruin Overlook area
- B = medium, Mummy Cave Overlook area
- C = dense, Tsaile Lake area

5 = Low Shrub-Grassland Communities
- A = Ledge Ruin Overlook area
- B = other areas, visitor center

6 = Sagebrushland Community

7 = Canyon Rim, Cliffs and Ledges
- A = Ledge Ruin Overlook area, western and southern exposure; rim, White House Overlook and Wild Cherry Canyon Overlook, mostly under 6400 ft
- B = other areas, northerly exposure or rim above 6400 ft (White House and Navajo Fortress)
- C = Wide Rock next to Spider Rock

c = common*
i = infrequent*
r = rare*
- = not observed

TR = trees
SH = shrubs
SS = sub-shrubs
PH = perennial herbs
VI = vines
SU = succulents
AN = annuals

* Determined subjectively—a function of conspicuousness, size and abundance.

about 1936. Other plants introduced into the canyon at various times after 1930 include: 3000 pounds of grass seed (kinds unspecified); apple, plum, peach, Chinese elm and mulberry trees, and grapevine (**Brugge and Wilson n.d.**) The native coyote willow (*Salix exigua*) is also prominent along the edges of the streambed throughout much of the canyon system.

Sandy terraces not under cultivation often contain large stands of *Phragmites communis*. On the drier sites *Atriplex canescens, Lycium pallidum* and *Opuntia phaeacantha* are found. Crevices in the canyon wall harbor *Vitis arizonica, Rhus radicans* or *Parthenocissus inserta*. Scattered *Celtis reticulata, Acer negundo* and *Juniperus osteosperma* can also be found on the canyon floor.

The upper parts of Canyon del Muerto support much denser growth. Two members of the Betulaceae, *Betula occidentalis* and *Alnus oblongifolia*, occur along the permanently running stream. *Acer negundo, Quercus gambelli, Pseudotsuga menziesii, Cornus stolonifera* and many herbs are common. Two species not known to occur anywhere else in the monument, *Picea pungens* and *Typha latifolia*, are found in upper del Muerto.

2. Talus Communities

Along the sheer cliffs of the lower canyon are talus slopes of varying height and rockiness, with slopes of 30 to 60 percent. Two kinds of southfacing talus were sampled in Canyon de Chelly: (a) that in Refuge Rock alcove is relatively short (about 30 m or 100 ft.) and is full of large boulders; (b) that near Spider Rock is longer (about 122 m or 400 ft.) and is less boulder-strewn with a great diversity of smaller rock sizes. The former, called rockfall talus, is at an elevation of about 1760 m (5800 ft.) and the latter, called rubble talus, is at about 1850 m (6100 ft.). A line 45 m (148 ft.) long was established on each of the two Talus Communities and plant intercept was determined. Rubble talus has three times (43 percent) the total perennial vegetative cover of rockfall talus (14 percent). If the large, plantless rocks are excluded in the computation, however, rockfall talus has 27 percent total cover. Cover composition differs as shown in Table 20; perennial species listed without cover values did not occur on the line, but were seen elsewhere on the talus slope.

No north-facing talus slopes were sampled, but the following species are known to occur there: *Acer negundo, Amelanchier utahensis, Fendlera rupicola, Philadelphus microphyllus, Pseudotsuga menziesii, Quercus gambelli* and *Rhus trilobata*.

Table 20. Talus communities cover composition (numbers in parentheses indicate percent cover).

ROCKFALL TALUS	*RUBBLE TALUS*
Grasses:	**Grasses:**
Aristida fendleriana (0.2)	*Bouteloua gracilis (0.4)*
Bouteloua curtipendula (0.5)	*Hilaria jamesii (0.2)*
Muhlenbergia sp. (0.2)	*Hordeum jubatum (0.2)*
Oryzopsis hymenoides (0.8)	*Oryzopsis hypenoides (5.8)*
Stipa comata (1.4)	*Poa fendleriana (0.2)*
Stipa speciosa (0.4)	*Sporobolus sp. (0.4)*
	Stipa comata
Herbs:	**Herbs:**
Asclepias engelmanniana	*Astragalus kentrophyta*
Astragalus sp.	*Brickellia sp.*
Brigeron flagellis	*Cirsium bipinnatum*
Mimulus eastwoodiae	*Evolvulus pilosus*
Mirabilis multiflora	*Penstemon barbatus*
Penstemon incana	*Tradescantia occidentalis*
Physalis fendleri	
Senecio longilobus	
Solidago sparsiflora	
Solanum elaeagnifolium	
Sphaeralcea fendleri	
Townsendia incana	
Tragia stylaris	
Shrubs:	**Shrubs:**
Artemisia tridentata (0.3)	*Amelanchier utahensis*
Atriplex canescens	*Brickellia scabra*
Cercocarpus intricatus (1.4)	*Chrysopsis villosus (0.8)*
Chrysopsis villosa	*Chrysothamnus nauseosus (3.5)*
Cowania mexicana (1.5)	*Ephedra viridis*
Fendlera rupicola	*Fendlera rupicola (6.8)*
Lycium pallidum	*Philadelphus microphyllus*
Philadelphus microphyllus	*Stephanomeria tenuifolia (3.7)*
Stephanomeria tenuifolia (3.8)	
Cacti & Succulents:	**Cacti & Succulents:**
Echinocereus fendleri	*Nolina microcarpa (0.9)*
Opuntia phaeacantha (1.2)	*Opuntia erinacea*
O. whipplei	*Yucca baccata*
Yucca angustissima	
Trees:	**Trees:**
Celtis reticulata	*Juniperus osteosperma*
Juglans major	*Pinus edulis (9.7)*
Juniperus osteosperma	*Quercus turbinella (10.0)*
Populus wislizenii	
Quercus turbinella (2.1)	

Table 21. Vegetation of Other Wet Places.

Acer negundo	*Oxypolis fendleri*
**Agrostis alba*	*Panicum capillare*
**A. semiverticillata*	*Parnassia parviflora*
Alnus oblongifolia	*Phragmites communis*
Alopecurus aequalis	*Plantago eriopoda*
Anemopsis californica	**P. lanceolata*
Betula occidentalis	**P. major*
Campanula parryi	**Poa compressa*
Carex lanuginosa	**P. pratensis*
C. Microptera	*Polygonum interruptus*
C. occidentalis	*P. monspeliensis*
Cicuta douglasii	*Populus acuminata*
Conioselinum scopulorum	**P. wislizenii*
Cornus stolonifera	*Prunella vulgaris*
Distichlis spicata	*Ranunculus aquatilis*
Echinochloa crusgalli	*R. cymbalaria*
**Elaeagnus angustifolia*	*R. macounii*
Elecharis macrostachya	*Rorippa obtusa*
Elymus canadensis	*R. sphaerocarpa*
Epilobium californicum	*Rudbeckia laciniata*
Equisetum arvense	**Rumex crispus*
E. hyemale	**Salix amygdaloides*
E. laevigatum	*S. exigua*
**Festuca elatior*	*Sarcobatus vermiculatus*
Glyceria striata	*Scirpus americanus*
Hypericum formosum	*S. microcarpus*
Juncus balticus	*Sisyrinchium demissum*
J. bufonius	**Tamarix ramosissima*
J. tracyi	**Trifolium repens*
Mentha arvensis	*Typha latifolia*
Mimulus guttatus	*Urtica gracilis (= U. dioica spp gracilis)*
Muhlenbergia asperifolia	*Veronica americana*
M. racemosa	*V. anagallis-aquatica*
M. wrightii	*Xanthium saccharatum (= S. strumarium)*

Table 22. Importance value and total arboreal coverage for three conifers at three elevations in the Pinyon-Juniper Continuum.

	Importance Value			
Elevation and Tree Density Designation	*Pinus edulis*	*Juniperus osteosperma*	*Juniperus scopulorum*	*% cover (trees)*
2195 m (7200 ft) Dense	221	69	9	52
2073 m (6800 ft) Medium	200	99	none	27
1890 m (6200 ft) Sparse	30	271	none	10

3. Springs, Seeps and Other Wet Places

Springs are not now common in Canyon de Chelly, but seeps frequently are found along cracks in the sandstone walls. These often support a growth of fern (*Adiantum capillus-veneris*), monkey-flower (*Mimulus eastwoodiae*), columbine (*Aquilegia micrantha*), grasses and the composite *Solidago sparsiflora*. In more protected areas, the fern *Crystopteris fragilis* is abundant. A seep near the head of Antelope Trial supports an orchid (*Epipactis gigantea*). Other species occurring in seeps, whether natural or man-made (such as those at the bases of stock watering ponds), are listed in Table 19, Column 3–B. A good description of "vegetation of seep and spring areas" in and near Glen Canyon can be found in Flowers (1959: 59–61).

"Other Wet Places" designates the streamside (riparian) vegetation of both the upper (Table 19, Column 1–B) and lower (Table 19, Column 1–A) canyons, which also form a portion of the Canyon Bottom Communities. The streamside components, which are not necessarily restricted to this habitat, are listed in Table 21; species preceded by an asterick are known to have been introduced into the canyon system, although *Populus wislizenii* and *Salix amygdaloides* may have been present prehistorically.

4. Pinyon-Juniper Continuum

Table 22 summarizes two general trends in the Pinyon-Juniper Continuum with rise in elevation. As would be expected with an increase in rainfall, there is a gradual increase in total arboreal cover, from 10 percent in the Sparse sections to 52 percent in the Dense sections of the continuum. The importance value reflects the fact that *Juniperus osteosperma* is relatively more abundant (98 percent) at lower elevations and that *Pinus edulis* becomes so (77 percent) at higher elevations. The lower stratum changes from an area (Low Shrub-Grassland) with *Chrysothamnus nauseosus, Hilaria jamesii* and *Gutierrezia sarothrae* as common components, to one (Medium Pinyon-Juniper) with abundant *Artemisia tridentata*, to one (Dense Pinyon-Juniper) with *A. tridentata* together with *Koelaria cristata, Bouteloua gracilis* and *Hymenoxis richardsonii* as common components.

Sparse Pinyon-Juniper
A quarter-method transect 165 m (541 ft.)

long provided all data, except for cover determined by Cooper's (1957) method. This transect was located just north of the Ledge Ruin Overlook Road. Pinyon accounts for only 7 percent of the trees in the slightly hilly (4 percent slope) area sampled, but it was observed to occur with greater frequency near bedrock drainages. Total arboreal cover is 10 percent. Brown and Lowe (1974) require a tree cover of 15 percent or more for the community to be considered a woodland.

Pinus edulis trees average 1.45 m (4.8 ft.) in height, with a maximum of 2.0 m (6.5 ft.); *Juniperus osteosperma* average 2.24 m (7.4 ft.), with a maximum of 3.6 m (12 ft.). Although the scattered understory was not sampled, the species listed in Table 23 occur in the vicinity.

Table 23. Vegetation of Sparse Pinyon-Juniper subgrouping

Trees:	**Herbs:**
Juniperus osteosperma	*Asclepias involucrata*
Pinus edulis	*Calochortus nuttallii*
	Delphinium scaposum
Shrubs:	*Linum puberulum*
Aster hirtifolius	*Lygodesmia grandiflora*
Chrysothamnus nauseosus	*Mentzelia albacaulis*
Ephedra viridis	*Phacelia sp.*
Gutierrezia sarothrae	*Physalis fendleri*
Grasses:	**Cacti & Succulents:**
Hilaria jamesii	*Opuntia erinacea*
Munroa squarrosa	*O. whipplei*
Oryzopsis hymenoides	*Sclerocactus whipplei*
Stipa comata	*Yucca angustissima*

Medium Pinyon-Juniper

A line intercept of 60 m (197 ft.) and a quarter-method transect were established over somewhat hilly terrain (up to 8 percent slope) near Mummy Cave Overlook, 200 m or more away from the rim. The upper story is composed of *Pinus edulis* trees averaging 2.9 m (9.7 ft.) high, with a maximum of 7.4 m (24 ft.), and of *Juniperus osteosperma* averaging 2.7 m (9.0 ft.) high, with a maximum of 3.6 m (12 ft.). The lower stratum cover is almost entirely *Artemisia tridentata*. Species found in the area are listed in Table 24, with percent cover given in parenthesis for those species occurring on the sample line.

Table 24. Vegetation of Medium Pinyon-Juniper subgroupings

Trees:	**Herbs:**
Acer negundo	*Calochortus nuttallii*
Juniperus osteosperma (6.2)	*Castilleja sp.*
Pinus edulis (21.1)	*Chaenactis steveoides*
Shrubs:	*Cryptantha sp.*
Amelanchier utahensis	*Gilia aggregata*
Artemisia tridentata (4.6)	*Hymenoxys richardsonii (0.2)*
Aster hirtifolus	*Lapulla redowskii*
Cercocarpus montanus	*Lepidium montanum*
Cowania mexicana	*Leptodactylon pungens*
Ephedra viridis	*Lesquerella sp.*
Fendlera rupicola	*Penstemon sp.*
Gutierrezia sarothrae	*Phlox sp.*
Haplopappus airoides	**Cacti & Succulents:**
Stephanomeria sp.	*Echinocereus triglochidiatus*
Grasses:	*Opuntia erinacea*
Hordeum jubatum (0.4)	*O. whipplei*
Oryzopsis hypenoides	*Yucca angustissima*
Poa fendleriana (0.08)	*Y. baccata*

Dense Pinyon-Juniper

A 50 m (164 ft.) line intercept and a quarter-method transect were run up a steepening slope (from 8 percent to 23 percent) west of Tsaile Lake near the head of Canyon del Muerto. The hills are covered with trees and the shallow drainages and flats with *Artemisia tridentata*. The upper stratum is dominated by *Pinus edulis* trees (48 percent cover), averaging 5.2 m (17.0 ft.) high, with a maximum of 10.7 m (35.0 ft.). *Juniperus osteosperma* averages 3.9 m (12.8 ft.) high, with a maximum of 6.4 m (21 ft.). Only one individual of *Juniperus scopulorum* was seen in the immediate vicinity of the line, but this juniper is more common in and around upper del Muerto and at higher elevations in the Chuska Mountains (Bent 1963; Wright et al. 1973). Table 25 lists species noted in the area or on the line, with percent cover given in parentheses, where known.

Table 25. Vegetation of Dense Pinyon-Juniper subgrouping

Trees:	**Herbs:**
Juniperus osteosperma (3.9)	*Cymopteris fendleri*
J. scopulorum	*Gilia aggregata*
Pinus edulis (47.8)	*Pendicularis centranthera*
Shrubs:	*Penstemon sp.*
Artemisia frigida	**Cacti & Succulents:**
A. tridentata (2.0)	*Coryphantha vivipara*
Cowania mexicana	*Opuntia erinaceae*
Hymenoxis richardsonii (1.2)	
Grasses:	
Bouteloua gracilis (1.3)	
Hordeum jubatum (0.5)	
Koeleria cristata (6.0)	

Table 26. Vegetation in and near Low Shrub-Grassland Communities.

Grasses:	**Herbs:**
Bromus tectorum	*Abronia elliptica*
Festuca octoflora	*Astragalus nuttallianus (0.04)*
Hilaira jamesii (14.0)	*Calochortus nuttallii*
Oryzopsis hymenoides	*Chaenactis stevioides*
Stipa comata	*Chenopodium sp.*
Shrubs:	*Cryptantha crassisepala*
Aster hirtifolius (.2)	*Cymopteris fendleri*
Chrysothamnus nauseosus (2.7)	*Delphinium scaposum*
Ephedra viridis	*Descurainia pinnata*
Gutierrezia sarothrae (6.9)	*Draba cuneifolia*
Lycium pallidum	*Gilia sinuata*
Succulents:	*Lygodesmia grandiflora*
Opuntia erinacea (0.02)	*Mentzelia albicaulis*
O. whipplei	*Oenothera albicaulis*
	Sphaeralcea sp.

Table 27. Perennial plants of the Sagebrushland Community.

Trees:	**Herbs:**
Juniperus osteosperma	*Calochortus muttallii*
Pinus edulis (1.4)	*Delphimium scaposum (0.5)*
Shrubs:	*Hordeum jubatum (0.1)*
Artemisia tridentata (27.2)	*Stipa comata (0.2)*

5. Low shrub-Grassland Communities

Along the western edges of the Defiance Uplift and of the monument, where the land slopes down to the Chinle Wash, the Low Shrub-Grassland interdigitates with Sparse Pinyon-Juniper. Only at the lower elevations, below 1800 m (5900 ft.), do the last of the *Juniperus osteosperma* disappear, leaving a continuous expanse of Low Shrub-Grassland. A 120 m (394 ft.) line intercept was established near Ledge Ruin Overlook. It traversed a depression (2 percent to 3.5 percent slope) along a drainage at about 1900 m (6200 ft.). Total perennial cover there is about 24 percent, with galleta (*Hilaria jamesii*) accounting for 14 percent and low shrubs (mostly *Gutierrezia sarothrae* and *Chrysothamnus nauseosus*) accounting for 10 percent. The overgrazed grass is inconspicuous.

Table 26 lists plants observed along the line (indicated by percent cover in parenthesis) and those noted in the vicinity of the line.

The plural "communities" is used here because in some areas *Sporobolus airoides* seems to be the dominant grass, rather than *Hilaria jamesii*, and in other areas, especially sandy ones, *Ephedra viridis* is at least a co-dominant shrub. Further quantitative data will be required to complete the definition of the communities.

6. Sagebrushland Community

This community is found on about 9 percent of the land above 1900 m (6200 ft.) within the monument. A 50 m (164 ft.) line intercept was placed in gently sloping (3 percent) terrain along the North Rim Road near its junction with Mummy Cave Overlook Road, at about 2073 m (6800 ft.). If all areas within this community prove to have as little diversity as does the one sampled, this is by far the most uniform Plant Resource Group of the seven presented here. The big sagebrush (*Artemisia tridentata*) accounted for 27.2 percent of the 29.5 percent total perennial vegetative cover and formed beautifully monotonous stands of strong-scented, gray-blue shrubs measuring 0.6 to 1.5 m (2 to 5 ft.) high.

Although individuals and groups of *Artemisia tridentata* plants occur below 1830 m (6000 ft.), they do not form a distinct community much below 2000 m (6600 ft.). The Medium and Dense portions of the Pinyon-Juniper Continuum form an interdigitating boundary with the sagebrushland flats. Sagebrush is found along drainage channels, while pinyon and juniper are found on the knolls and higher ground. This boundary is not static, however, since one can find small junipers and pinyon pines colonizing the sagebrush and since the sagebrush forms a prominent part of the understory in parts of the Pinyon-Juniper Continuum.

The few perennial plants listed in Table 27 illustrate the low diversity of this community (numbers in parentheses give percent cover).

7. Canyon Rim, Cliffs and Ledges

At Ledge Ruin Overlook, a transect 80 m (262 ft) long was run from 45 m (150 ft.) below the rim up to a point 75 m (246 ft.) into the Sparse Pinyon-Juniper of the plateau. Rim arboreal cover (15 percent) is composed primarily of *Pinus edulis* (14 percent), with *Juniperus osteosperma* (1 percent) and *Quercus turbinella* (0.2 percent) also present. The below-rim, or ledge, tree cover is about 10 percent, with *Quercus turbinella* accounting for 1.5 percent (assuming all plants as trees) and *Juniperus osteosperma* accounting for 7.3 percent, with a few *Pinus edulis* plants present, none of

which fell on the line. *Quercus turbinella*, which grows both as a tree and as a tall shrub, forms a significant part of the above-rim vegetation at other locations, such as White House Overlook, but it rarely extends more than 100 m or so from the rim.

Ledge vegetation varies greatly with exposure and elevation. Ledges facing north and east support a much denser growth and exhibit a flora composition unlike those facing south and west at similar elevations. Examination of three generally north-facing ledges (elevation 1830 to 1920 or 6000 to 6300 ft.) on Navajo Fortress at the confluence of Black Rock and del Muerto canyons revealed that the ledges had not been grazed by sheep, goats, cattle or horses. However, five or six steel blade-cut *Juniperus osteosperma* stumps, one measuring about 50 cm in diameter, along with two or three archeological sites and a toe-and-handhold trial, give proof that man has used this area within the past 1000 years.

The transect over the rim near Ledge Ruin Overlook encountered two southwest-facing ledges at 1830 to 1890 m (6000 to 6200 ft.); these may be contrasted vegetationally with those from the northerly exposure of Navajo Fortress. The conspicuous perennial plants common to both the north-facing and south-facing ledges are *Amelanchier utahensis, Artemisia tridentata, Cercocarpus intricatus, Clematis ligusticifolia, Ephedra viridis, Eurotia lanata, Juniperus osteosperma, Pinus edulis, Poa fendleriana, Yucca angustissima* and *Y. baccata*. The most noticeable differences between the two ledge exposures, other than the generally denser vegetation on north-facing slopes, are the extensive moss and *Selaginella mutica* ground cover on the moister portions of the north-facing ledges and the *Quercus turbinella* scattered over the south-facing ledges. (For a more complete listing or plants which occur in each of these areas on Wide Rock, see Table 19.)

Table 28 lists species recorded on the essentially pristine Canyon Rim, Cliffs and Ledges of Wide Rock Butte (Schmutz *et al.* n.d.), where an intensive environmental analysis was conducted (numbers in parenthesis give percent cover).

Table 28. Species recorded on Canyon Rim, Cliffs and Ledges of Wide Rock Butte.

Trees:
Juniperus osteosperma (4.0)
Pinus edulis (0.6)
P. ponderosa
Pseudotsuga menziesii
Quercus gambelii
Q. turbinella
Shrubs:
Amelanchier utahensis
Artemisia bigelovii (6.0)
A. tridentata
Brickellia californica (0.2)
B. scabra
Cercocarpus intricatus (9.6)
Chrysothamnus nauseosus (0.01)
Ephedra viridis (1.6)
Gutierrezia sarothrae (0.7)
Herbs:
Asclepias asperula
Artemisia ludoviciana (0.2)
Aster hirtifolius (0.4)
Calochortus nuttallii
Carex oerocharis (0.2)
Cheilanthes feei
Chrysopsis villosa
Cryptatha bakeri
C. fulvocanescens
Draba cuneifolia
Eriogonum simpsonii
Haplopappus armerioides (0.1)
H. nuttallii
Juncus sp.
Lactuca sp.
Lappula redowskii
Linum aristatum
Penstemon sp.
Selaginella mutica
Senecio multilobatus
Silene sp.
Solidago graminea (0.2)
Stephanomeria tenuifolia
Herbs (cont.)
Streptanthus cordatus (0.01)
Tragia stylaris
Tragopogon sp.
Grasses:
Agropyron smithii
A. trachycaulum
Aristida fendleriana (0.1)
A. glauca (0.1)
A. longiseta (0.1)
Bouteloua curtipendula (0.3)
B. gracilis
Bromus tectorum
Festuca octoflora
Hilaria jamesii
Koeleria cristata
Lycurus phleoides (0.2)
Muhlenbergia depauperata
M. montana (0.2)
M. racemosa (0.1)
M. pauciflora
M. thurberi
Oryzopis hymenoides (0.6)
O. micrantha
Poa fendleriana (0.3)
Schizachyrium scoparium (Andropogon scoparius)
Sitanion hystrix (0.1)
Sporobolus airoides
S. cryptandrus
Stipa letermanii (0.1)
S. comata
S. neomexicana (0.1)
S. speciosa
Cacti and Succulents:
Echinocereus triglochidiatus
Opuntia sp. (0.4)
O. erinacea (2.5)
O. whipplei (0.5)
Yucca angustissima
Y. baccata (4.5)

Summary

Some statistical analysis was done on representative portions of four of the seven groups, distribution of which is illustrated in Figure 31. Three of these, the Sagebrushland Community, the Pinyon-Juniper Continuum and the Low Shrub-Grassland Communities, are well characterized by naming and quantifying their few dominant perennial species, whether one analyzes by statistical technique or by simple observation. These easily defined communities owe much of their simplicity to plateau terrain, which is topographically uniform. Here, soil and elevational gradients are the overriding factors controlling plant establishment and growth.

The fourth sampled resource group, Canyon Rims, Cliffs and Ledges, contains a highly diverse flora, which varies greatly with exposure and elevation; this group and Talus Communities, except where situated on in accessible ledges, are heavily overgrazed. The Canyon Bottom Communities exhibit an even greater diversity of plant species, due in part to the inclusion of plants from the very different habitat of the upper canyon bottoms. This resource group is perhaps the least "natural," due to the disturbance of man and his introduced plants and animals. Cultivated fields have existed here for 1000 years or more. Overgrazing, though not restricted to the canyon bottoms, is evident.

It is probable that the following factors influence the distribution of species found in Springs, Seeps and Other Wet Places: (1) microenvironmental variations in available moisture, (2) size of habitat, (3) coincidence of disseminules, (4) quality and quantity of water and substrate and (5) exposure. Examples of dominant forms in any particular wet area may be mesic or hydrophytic and may include ferns, forbs or grasses.

The last four resource groups, Wet Places, Canyon Bottom, Talus and Rim, are distinguished primarily by topographic features, rather than by common dominant plant species. It follows that these groups need a much more extensive analysis to determine whether they can be categorized into vegetational communities. Talus slopes, specifically, could be better characterized by employing an intensive grid arrangement in vegetational sampling. These slopes have drainage patterns and soil gradients which tend to create a non-random distribution of plant species.

Our seven category system in inadequate in the upper parts of the canyon system, where Wet Places, Canyon Bottom, Talus and Rim form a continuum. Intensive sampling will be needed in order to determine whether and where community boundaries exist.

The exclusion of annual flora was a regrettable necessity. The most meaningful data on annuals would have to be gathered over a period of years, due to great variation in suitable growing conditions from year to year. The relationship of pinyon-juniper to the brush communities, which are here considered its associates, is ripe for study. Suggested lines of investigation include: (1) definition of time at which tree invasions took place might be determined by dendrochronological methods and correlations with climatic cycles might be made; (2) reproductive potential, as shown by seedlings of both trees and shrubs at different elevations, could be investigated to provide models of intercommunity dynamics (e.g., pine seedlings were abundant in Sparse and Medium, but not in Dense, pinyon-juniper); (3) determining whether or not there is a nurse plant relationship between trees and shrubs (in some areas *Artemisia tridentata* is found clustered around bases of pinyon and juniper trees); (4) determining whether the apparent swapping of galleta-rabbitbrush for sagebrush as the complement of pinyon-juniper is a result of soil-moisture availability and (5) determining what microenvironmental or other differences account for shrub vs. tree sites.

Chapter 10

The Past Environment of Canyon de Chelly

Conditions of preservation at Antelope House allowed the recovery, in highly identifiable form, of more than two tons of vegetal material. Although the volume of material was great, time and funds permitted the identification of only some 462 kg (1016 lbs.) of macrovegetal refuse, more than 2400 vegetal artifacts, and a quantity of charcoal, pollen and other materials identifiable only by microscope. Such a wealth of botanical information suggested the possibility of answering two intriguing questions. What was the climate like at Antelope House during Anasazi times? How were the occupants of Antelope House affected by that climate?

The species composition of the vegetal remains made it clear that the inhabitants of the village depended heavily upon the cultivation of maize (over 39 percent of the gross vegetal weight was contributed by *Zea mays*) and that the climate, if different at all from that of the present, could not have been drastically different. Of all species (or genera) identified from the site, fewer than 11 percent are not presently known to occur in the monument (Table 29) and about half of these may be expected to occur nearby (McDougall 1973).

Despite the importance of cultivars and the small qualitative differences between the past and present array of plant species, there were indications from the faunal material that a paleoclimatic investigation based on vegetal remains was in order. Among the avian remains were the bones of at least three mallards (*Anas platyrhynchos*), one gadwall (*A. strepera*), a green-winged teal (*A. carolinensis*) and a white-necked raven (*Corvus cryptoleucus*). Mallard, gadwall and shoveler (*Spatula clypeata*) feathers also were found, as were 12 feathers from unidentified ducks (see Chapter 12). Except for scarlet macaw (*Ara macao*) feathers, which are known to have been widely diffused trade items, the balance of the avian remains come either from turkeys domesticated by the Anasazi or from birds likely to be found in the area today.

There are at present no natural habitats suitable for ducks nearer to Canyon de Chelly than some small lakes in the Chuska Mountains. Since both bones and feathers were recovered from the site, it seems unlikely that ducks were trade items. If ethnographic parallels are any indication (Ford 1968: 98, 140, 142), it is equally unlikely that the Anasazi undertook expeditions of any length to obtain small game. The presence of duck remains at the site, therefore, suggests an environment more favorable to waterfowl than the present one; that is, a wetter canyon, with a complement of ponds, marshes or backwaters.

The white-necked raven has, in modern times, never been found north of Winkelman in southern Arizona (Phillips, Marshall and Monson 1964: 106–107); it normally resides only in the desert grasslands of the southeastern corner

Table 29. Plants recovered from Antelope House ruin, but not known to occur at present in Canyon National Monument.

Family	*Species*	*Common Name*	*Elevational Range* in Arizona (ft)*
Pinaceae (pine family)	*Abies lasiocarpa*	alpine fir	8000–12,000
Gramineae (grass family)	*Eragrostis diffusa*	spreading lovegrass	1000–7000
	Phelaris arundinacea	reed canarygrass	4500–9000
	Setaria leucopila	bristlegrass	2000–6000
	Sporobolus asper	tall dropseed	4000–6000
	Sporobolus contractus	spike dropseed	1500–6000
Liliaceae (lily family)	*Allium macropetalum*	textile onion	4000–7500
Chenopodiaceae (goosefoot family)	*Cycloloma atriplicifolium*	tumble ringweed	1000–6000
	Rumex humenosepalus	wild rhubarb	1000–6000
Cactaceae (cactus family)	*Pediocactus* (cf. *bradyi*)		4000
Elaeagnaceae (oleaster family)	*Shepherdia rotundifolia*	roundleaf buffaloberry	5000–8000
Labiatae (mint family)	*Poliomintha incana*	wild basil	4500–6000
Martyniaceae (unicorn-plant family)	*Proboscidea parviflora*	devilsclaw	1000–5000
Compositae (sunflower family)	*Artemisia filifolia*	sand sagebrush	4000–6000
	Aster foliaceus	aster	7500–9500
	Chrysopsis foliosa	goldenaster	3000–8500
	Pectis angustifolia	fetid-marifolg	3500–7000

* Data are from Kearney and Peebles (1960), except for *Pediocactus*, which is from McDougall (1973); for *Sporobolus asper*, which is from Kearney and Peebles (1960) and Harrington (1954); and for *Phalaris*, which is from Harrington (1954).

of the state. This species is virtually impossible to distinguish in the field from the common raven (*Corvus corax*), even by experts, making it highly unlikely that the presence of one bone at Antelope House signifies cultural selection. The bone may represent a singular occurrence—the capture of killing of a particularly errant individual or the death of a tame animal brought up by a southern wanderer—but it probably bespeaks warmer, wetter times and more widespread grasslands. Such a hypothesis, at least, is consistent with the presence of ducks in the area and requires fewer assumptions to explain the data than do alternative explanations.

Scaled quail (*Callipepla squamata*) presently occur in the upper Little Colorado drainage, although they are thought to have been introduced there from their usual grassland habitats in southeastern and south central Arizona (Phillips, Marshall and Monson 1964: 29). If they were introduced, the presence of one of their feathers at Antelope House lends additional support to the hypothesis of a more benign climate in Anasazi times. As feathers constitute ideal trade items, however, this evidence is only slightly corroborative.

The mammal remains include the bones of at least eight muskrats (*Ondatra zibethicus*) and a beaver (*Castor canadensis*) (see Chapter 13). The muskrat's range within the state today is restricted to watersheds distant from Canyon de Chelly: the lower Colorado River valley and the "Gila River, its tributaries and the White Mountain area" (Cockrum 1960: 210–212). Beaver now live in the upper parts of the de Chelly canyon system. Although Cockrum does not note this (1960: 154–156), he does say that they were "formerly widespread in all of the permanent streams of the state" (1964: 254). The bones of both species argue that during at least part of the occupation of Antelope House, the canyon enjoyed an ample supply of living water. The animal remains, in short, suggested that significant, if not dramatic, environmental change probably occurred in Canyon de Chelly between Anasazi times and the present. An analysis of the much

more extensive vegetal remains was expected to test this hypothesis and to allow a finer interpretation of any changes during the period of occupation and of their effects on the people of Antelope House.

Methods and Results

The raw data for this paleoclimatological analysis were generated by the sorting and identification of macrovegetal refuse, vegetal artifacts and microvegetal remains discovered by flotation. The plant species to be discussed are listed in Appendix F, along with information on their ethnographic uses, modern occurrence in the monument and archeological recovery from Antelope House.

The distribution of plant species is strongly influenced by climatic factors. Because vertical distribution in Arizona's basin and range topography provides a useful gauge of plant tolerance to temperature (at the upper limit of elevational range) and to available moisture (at the lower limit) (Lowe 1964: 87), the elevational range of each species studied was used to determine whether there is a statistically significant difference between the present and past vegetation of Canyon de Chelly. Elevational extremes were taken principally from Kearney and Peebles (1960), with gaps filled by data from McDougall (1973) and Harrington (1954).

The extremes for each species were averaged to produce a mathematical mean elevation for that species. Where not specifically given, lower limits were fixed at 10,000 ft., approximately the upper limit of the Hudsonian life zone (Lowe 1964: 74). The mean, standard deviation and standard error were calculated for elevational maxima, elevational means and elevational minima for each of four groups: (1) species found in Canyon de Chelly *only* in an archeological context at Antelope House (Table 29); (2) *all* species found in an archeological context at Antelope House; (3) all species known to occur at present in the monument; and (4) those species in Category 3 known to have ethnographic uses. Cultivars, recent introductions and plants identified only to genus or higher taxon, are omitted from these calculations, with the exception of *Pediocactus* sp., which is treated as *P. bradyi*, which the archeological remains resemble (A.E. Dennis 1974: personal communication). The results are presented in Table 30.

Although archeological material probably provides a biased sample of the past vegetation, at least some of that bias probably is compensated for by comparing the archeological sample to just those current species of known ethnographic use. The relative deviate (the difference of the means between any two groups divided by the square root of the sum of each of their standard errors squared) of various groups was calculated and the significance of the difference in means determined by a "two-tail" test, using a standard statistical table of areas of the normal curve (Rohlf and Sokal 1969: 158). Results are presented in Table 31. There was no significant difference (at the 5 percent level) in the means of all current species when compared to those of known ethnographic use, nor in the means of species found only archeologically when compared with all current or current ethnographic species.

Inspection of the 17 exclusively archeological species and of the elevational data shows that it is only the small size of the sample and the inclusion of two high-elevation species (*Abies lasiocarpa* and *Aster foliaceus*) which preclude the statistical significance of the means for this group. Modern puebloan farmers, associating higher elevations with water and, therefore, with agricultural deities, travel considerable distances to collect montane plants for ceremonial and medicinal purposes (Ford 1968: 142–144; Whiting 1939: 42). It is tempting to speculate that fir was used in religious rituals, much as the Hopi today employed the similar Douglas fir (*Pseudotsuga menziesii*) in kachina costumes and plaza altars, and that the bundles of foliage from the showy blue aster were gathered as medicine from a sacred region. Be that as it may, the balance of the exclusively archeological species show a definite affinity for elevations generally lower than that of Canyon de Chelly. It was this observation that initially gave reason to believe that the archeobotanical material could shed light on the climates of the past.

As Table 31 shows, the means of elevational extremes and elevational average of all archeological species are significantly different from those of the current species array and, except for the minimum limit, also significantly different from those current species of known ethnographic use.

Table 30. A comparison of elevational ranges of four plant species populations from Antelope House and Canyon de Chelly National Monument (all figures are rounded to the nearest whole number).

	Species found only in an archeological context	*All species* found in an archeological context*	*All species* known to occur at present in the Monument*	*Species of known ethnographic use which occur in the Monument*
Sample size	17	113	447	301
Mean maximum elevation (ft)	7000	7459	7737	7751
Standard deviation	1912	1163	1598	1346
error	464	109	76	78
Mean average elevation (ft)	5097	5214	5678	5564
Standard deviation	1945	1339	1557	1443
error	472	125	74	83
Mean minimum elevation (ft)	3218	3033	3668	3404
Standard deviation	2349	1935	2137	1980
error	570	182	101	114

* see text for exceptions.

Table 31. Significance of the difference in elevational means between archeological and current plant species of Canyon de Chelly National Monument.

	Relative deviate	*P (2-tail)*
All archeological species from Antelope House compared to:		
All species* known to occur at present in the Monument:		
Maximum elevations	2.09	.0366
Mean elevations	2.83	.0046
Minimum elevations	3.05	.0022
Species of known ethnographic use which occur in the Monument:		
Maximum elevations	2.18	.0292
Mean elevations	1.99	.0466
Minimum elevations	1.73	.0836

* see text for exceptions.

In spite of the fact that ethnographic species do not differ significantly in their vertical distribution from the whole of the current species array, Table 31 demonstrates a consistent inverse trend of significance when each of these two groups is compared to archeological material; differences become increasingly significant from upper to lower limits in the total array of species and vice-versa in the ethnographic group. Table 30 shows that although ethnographic species have a higher mean maximum limit, both the mean average elevation and the mean minimum elevation are lower than those of current species. These relationships suggest that, as a whole, species of known ethnographic use cluster at lower elevations than are characteristic of the entire

species array. This is not surprising, for at least two possibly related reasons: (1) indigenous populations tended to inhabit the lower elevations, with only occasional forays into the higher mountains; and (2) the plant species diversity at lower elevations tends to be greater than that at higher elevations. For these reasons, and because of the ceremonial use of high-elevation plants, the bias possibly introduced by cultural selection must be taken into account when interpreting past climate on the basis of archeological materials.

Table 30 also shows that all means for archeological material are lower than those for both groups of current species. If these data are interpreted as reflecting a difference in the principal factors limiting vertical distribution, they suggest that in the past, residents of the canyon experienced higher temperatures and less available moisture than they might at present. But even if these results are not due entirely to cultural selection, they say nothing about when hotter and drier conditions obtained. The proveniences of all materials from the site were recorded, however, and since many of these proveniences could be reliably dated, a more precise analysis, employing temporal and spatial controls, was undertaken. A computer listing provided a tabulation of the total weight of each species (or other taxon) identified from the macrovegetal refuse, broken out by period (BMIII, PI, PIII, EPIII, MPIII, LPIII, Mixed, Navajo), by room block (South Room Block, North Room Block, Central Room Block, South Area) and by each period in each room block. A similar tabulation of species used in vegetal artifacts was produced, but it was cross-tabulated by the number of each type of artifact containing a given species, rather than by weight. Analogous data on cordage, textiles and so on also were retrieved for analysis. Since the breakdown by room block seemed to add no useful information for our purposes, data for the whole site are utilized.

Because ruins stabilization received first priority, a systematic sampling of the site for cultural periods was impractical, if not impossible. The surface layers not only were more accessible, but their excavation constituted little threat to the stability of the ruin's foundation. The raw data, therefore, over-represented later periods of Anasazi occupation. Late Pueblo III proveniences, in particular, are disproportionately represented (Fig. 32) and provided an exceedingly large percentage of all materials recovered. Proveniences for vegetal analysis were selected so that they adequately represent the distribution of proveniences excavated (except for Pueblo I proveniences, which were not dated soon enought to allow analysis).

Two problems remained. Was the exponentially increasing amount of material recovered due solely to sampling bias and/or differential preservation, or had there in fact been an increase in productivity during late Pueblo III times? How could the amount of material validly be compared from period to period? The second question was a particularly important one, because without knowing how the samples were comparable, it would be impossible to make reasonable inferences as to their significance.

The method of delimiting proveniences (see Chapter 2) resulted in units of widely different size, some as small as .004 m^3, others as large as 1020 m^3. Since measurements were taken on almost all floor contact proveniences (as well as on a number of other proveniences, such as trash, feature fill, hearth fill, room fill, cist fill, subfloor fill and post fill), however, it was possible to compute mean provenience volumes for Pueblo II, Early Pueblo III, Middle Pueblo III and Late Pueblo III (Table 32). The sum of floor-contact proveniences is, as expected, fairly representative of provenience distribution from Pueblo II through Late Pueblo III. Although non-floor-contact proveniences are less representative of overall distribution, both figures were used to compute the mean provenience volume for each of the last four Pueblo periods, in order to increase the accuracy of that computation. Mean provenience volume ($\bar{v}$) was calculated by the following formula (a = the number of floor-contact proveniences, v_1 = the mean volume of floor-contact proveniences, b = the number of non-floor-contact proveniences and v_2 = the volume of non-floor-contact proveniences):

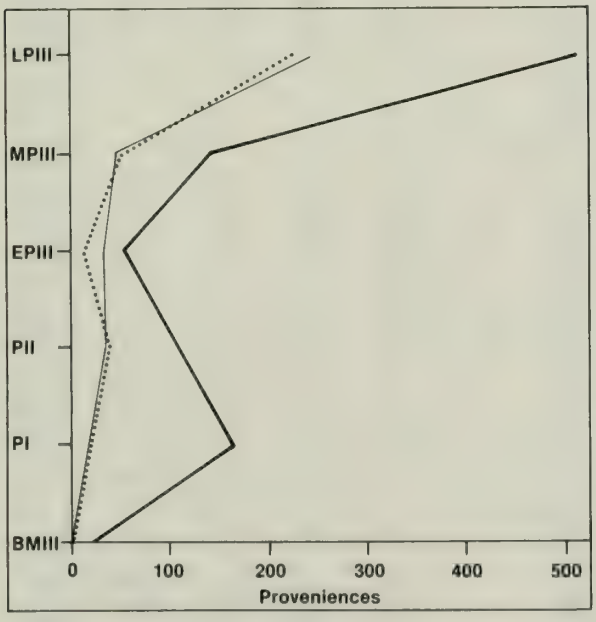
$$\frac{av_1 + bv_2}{a + b} = \bar{v}$$

For each analysis of change through time, the mean provenience volume for a given period was multiplied by the number of proveniences from which the material in question had been analyzed. The resulting figure was used as an adjusting divisor for whatever measure of quan-

Table 32. Provenience data.

	Undatable	*BMIII*	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*PIII*	*Mixed*	*Navajo*
Total number of proveniences	342	26	169	113	57	145	526	27	58	27
No. from which macrovegetal refuse analyzed	17	1	10	39	14	52	227	11	14	17
No. from which vegetal artifacts analyzed	89	0	11	37	33	46	245	6	22	5
No. from which sandals analyzed	36	1	6	17	11	24	79	0	10	1
No. from which cordage analyzed	232	3	25	46	35	80	293	11	14	12
No. from which textiles analyzed	52	0	7	13	12	32	141	4	15	9
No. of floor-contact measured	—	—	—	15	6	21	101	—	—	—
No. of non-floor contact measured	—	—	—	7	22	24	68	—	—	—
Total volume of measured floor-contact proveniences (m^3)	3.88	1.5	.37	6.15	4.91	6.45	54.21	.20	0	0
Total volume measured non-floor contact proveniences (m^3)	23.54	1.96	1.79	1.99	12.64	21.56	32.29	1.43	12.8	0
Average volume of proveniences (m^3)	—	—	—	.386	.584	.778	.486	—	—	—

Figure 32. Numbers of proveniences analyzed, by period.



tity originally had been chosen. When comparing the macrovegetal recovery from each period, for example, the total weight of a species recorded from that period was divided by the adjusting divisor; when comparing vegetal artifacts, the number of artifacts in which a given species was utilized was divided by the adjusting divisor; when comparing textiles, the square meters recovered per period was the dividend, and so on. The quotients represent weight per average provenience volume, number of artifacts per average provenience volume, square meters per average provenience volume, and so on. These dimensioned numbers are considered the most reliable measure we have of the relative differences in use of plant resources by the people of Antelope House from about AD 900 to about AD 1275, since the relatively small size of Late Pueblo III proveniences was evident during excavation of the ruin. Nonetheless, a second adjustment was made by simply using the number of proveniences in each period as the adjusting divisor, since it was felt that confidence in the results of the analysis could be greater if the two methods

Table 33. Macrovegetal recovery, by species and period.

Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
Abies lasiocarpa					
EPIII	4.3	.355	100	.13	100
Acer negundo					
PI	3.7				
PII	25.5	2.10	2.20	.77	3.06
EPIII	166.8	32.32	33.99	11.91	47.37
MPIII	183.6	5.92	6.22	3.53	14.04
LPIII	2001.4	54.74	57.57	8.93	35.52
PIII	50.1				
Navajo	2.8				
Mixed	192.8				
Undated	26.5				
Amaranthus powellii					
EPIII	.6	.116	17.28	.042	29.37
MPIII	.8	.025	3.72	.015	10.48
LPIII	19.4	.530	78.98	.086	60.14
Allium cernuum					
PI	.3				
Allium macropetalum					
LPIII	.5	.013	100	.002	100
Allium sp.					
EPIII	.8	.155	33.84	.057	28.5
MPIII	6.8	.219	47.81	.130	65.0
LPIII	3.1	.084	18.34	.013	6.5
PIII	.1				
Mixed	.3				
Artemisia ludoviciana					
MPIII	.1	.003	.20	.001	14.28
LPIII	53.8	1.47	99.79	.006	85.71
Artemesia sp.					
BMIII	.1				
PI	22.5				
PII	166.9	13.79	6.85	5.05	7.71
EPIII	559.4	108.41	53.84	39.95	61.06
MPIII	537.8	17.35	8.61	10.34	15.80
LPIII	2259.1	61.79	30.69	10.08	15.41
PIII	7.6				
Navajo	2.1				
Mixed	55.7				
Undated	37.3				
Artemesia tridentata					
EPIII	9.1	1.76	100	.65	100
Aster sp.					
LPIII	.5	.013	100	.002	100
Navajo	.2				
Atriplex canescens					
PII	1.0	.082	94.25	.030	96.77
LPIII	.2	.005	5.75	.001	3.23
Navajo	.3				
Atriplex confertifolia					
LPIII	.1	.002	100	.0004	100
Atriplex jonesii					
LPIII	2.1	.057	100	.009	100
Artiplex sp.					
PII	8.0	.66	72.68	.242	85.82
LPIII	9.1	.248	27.31	.040	14.18
Berberis sp.					
LPIII	.6	.016	100	.0026	100
Celtis sp.					
PII	.1	.008	27.59	.003	50
LPIII	.8	.021	72.41	.003	50
Navajo	1.2				
Undated	1.5				
Cenchrus pauciflorus					
Navajo	.1				
Chenopodium berlandieri					
PII	2.2	1.818	25.02	.066	6.06
MPIII	9.6	.309	4.252	.185	16.97
LPIII	187.9	5.139	70.73	.838	77.02
Chrysothamnus sp.					
LPIII	.8	.021	100	.003	100
Clematis ligusticifolia					
MPIII	.7	.022	62.86	.013	86.67
LPIII	.5	.013	37.14	.002.	13.33
Cleome serrulata					
PI	1.8				
PII	5.6	.462	7.11	.170	7.37
EPIII	10.7	2.07	31.84	.764	33.1
MPIII	31.9	1.029	15.83	.613	26.6
LPIII	170.5	2.94	42.22	.761	33.0
PIII	9.3				
Navajo	11.1				
Mixed	2.5				
Undated	1.9				
Coniferous wood					
PI	66.7				
PII	263.4	21.76	12.78	7.981	16.28
EPIII	355.5	68.89	40.45	25.39	51.81
MPIII	189.7	6.12	3.60	3.64	7.43
LPIII	2689.2	73.55	43.13	12.00	24.50
PIII	30.0				
Cucurbitaceae					
PI	20.0				
PII	285.9	23.62	5.41	8.66	8.09
EPIII	296.7	57.5	13.18	21.19	19.80
MPIII	1379.7	44.52	10.21	26.53	24.78
LPIII	11,345.5	310.32	71.18	50.64	47.31
PIII	1600.8				
Navajo	14.0				
Mixed	186.3				
Undated	46.6				
Cucurbita mixta					
LPIII	.1	.002	100	.0004	100
Cucurbita pepo					
PII	78.5	6.48	8.94	2.37	12.89
EPIII	110.9	21.49	29.66	7.92	43.07
MPIII	60.8	1.96	2.71	1.16	6.31
LPIII	1555.2	42.53	58.69	6.94	37.74
PIII	64.9				
Navajo	37.3				
Mixed	73.3				
Undated	42.9				
Cucurbita sp.					
PI	91.5				
PII	501.5	41.44	17.10	15.19	18.94
EPIII	600.1	116.29	48.00	42.86	53.44
MPIII	598.2	19.30	7.97	11.50	14.34
LPIII	2386.8	65.28	26.94	10.65	13.28
PIII	103.7				
Navajo	7.9				
Mixed	6.7				
Datura sp.					
PI	.2				
LPIII	3.4	.092	100	.015	100
Navajo	.9				
Undated	.7				
Elymus canadensis					
MPIII	.2	.006	100	.003	100
Eragrostis diffusa					
LPIII	70.3	1.92	100	.313	100
Ephedra sp.					
PII	19.3	1.59	6.03	.584	10.09
EPIII	86.4	16.74	63.43	2.62	45.25
MPIII	90.0	2.90	10.99	1.75	30.21
LPIII	188.8	5.16	19.55	.842	14.55
PIII	3.2				
Mixed	.8				
Equisetum hyemale					
PI	1.1				
PII	2.3	.190	4.7	.069	6.5
EPIII	7.8	1.51	37.39	.557	52.45

Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
MPIII	1.7	.054	1.34	.032	3.01
LPIII	90.5	2.475	61.28	.404	38.04
PIII	.6				
Mixed	.9				
Equisetum laevigatum					
EPIII	.5	.096	16.87	.035	94.6
LPIII	17.3	.473	83.13	.002	5.41
Equisetum sp.					
PI	.1				
PII	2.8	.231	35.51	.084	53.95
MPIII	.3	.0096	1.48	.0057	3.66
LPIII	15.0	.410	63.01	.066	42.39
Mixed	.9				
Undated	.1				
Fendlera rupicola					
MPIII	.9	.029	100	.017	100
Fiber, unidentified					
PI	1.0				
PII	53.4	4.41	7.60	1.612	9.44
EPIII	152.2	29.49	50.80	10.87	63.67
MPIII	46.9	1.51	2.60	.901	5.28
LPIII	827.4	22.63	39.0	3.69	21.61
PIII	10.3				
Navajo	2.8				
Mixed	15.0				
Undated	9.2				
Gossypium hirsutum					
PI	20.6				
PII	4.2	.347	6.33	.127	1.09
EPIII	28.3	5.484	10.29	2.02	17.35
MPIII	126.7	4.088	7.67	2.43	20.88
LPIII	1585.2	43.35	81.38	7.07	60.74
PIII	3.7				
Navajo	2.6				
Mixed	49.5				
Undated	30.3				
Gutierrezia sarothrae					
LPIII	20.8	.568	100	.092	100
Gutierrezia sp.					
MPIII	9.7	.313	100	.186	100
Helianthus annuus					
EPIII	4.0	.775	56.52	.285	74.61
MPIII	.1	.003	.23	.001	.26
LPIII	21.7	.593	43.25	.096	25.13
Navajo	.6				
Helianthus sp.					
EPIII	4.0	.775	43.74	.285	32.80
MPIII	30.2	.975	55.02	.581	66.86
LPIII	.8	.022	1.24	.003	.34
Split woody herbs					
PII	47.5	3.925	9.361	1.439	13.252
EPIII	74.4	14.41	34.370	5.314	48.940
MPIII	18.3	.590	1.407	.351	3.232
LPIII	840.9	23.00	54.859	3.754	34.573
PIII	.3				
Navajo	1.8				
Mixed	15.6				
Undated	46.5				
Herbaceous roots					
PI	.1				
MPIII	60.8	1.961	19.77	1.169	97.09
LPIII	290.9	7.957	80.23	.035	2.91
Navajo	.1				
Hollow woody herb with thin yellow bark					
PII	7.3	.603	6.33	.221	6.65
EPIII	32.2	6.24	65.48	2.3	69.13
MPIII	26.3	.849	8.01	.506	15.20
LPIII	67.2	1.84	19.29	.3	9.02
Juglans sp.					
PII	36.4	3.01	27.67	1.103	28.694
EPIII	29.8	5.775	53.12	2.129	55.385
MPIII	19.4	.626	5.76	.373	9.703
LPIII	53.5	1.463	13.46	.239	6.217
PIII	1.9				
Navajo	1.6				
Mixed	8.0				
Undated	.8				
Juniperus osteosperma					
PI	5.0				
PII	9.3	.769	5.16	.282	9.51
EPIII	9.5	1.841	12.36	.679	22.9
LPIII	448.9	12.28	82.47	2.004	67.59
PIII	.7				
Navajo	.1				
Juniperus sp.					
BMIII	.2				
PI	358.6				
PII	3095.2	255.8	12.26	93.79	13.35
EPIII	3432.0	665.11	31.89	245.14	34.89
MPIII	12,427.3	401.01	19.23	238.99	34.02
LPIII	27,923.5	763.77	36.62	124.66	17.74
PIII	98.1				
Navajo	12.7				
Mixed	436.1				
Undated	745.9				
Lagenaria siceraria					
PII	.1	.008	16.33	.003	30
MPIII	.1	.003	6.12	.001	10
LPIII	1.4	.038	77.55	.006	60
Leaves, unidentified					
PI	.3				
PII	10.7	.884	29.213	.324	35.60
EPIII	4.0	.775	25.611	.286	31.43
MPIII	5.5	.177	5.85	.106	11.65
LPIII	43.5	1.19	39.326	.194	21.32
PIII	.1				
Mirabilis multiflora					
EPIII	18.4	3.565	100	1.314	100
Mirabilis sp.					
PII	4.3	.355	.794	.130	.870
EPIII	186.8	36.20	80.98	13.34	89.226
MPIII	10.8	.350	.783	.208	1.391
LPIII	285.2	7.800	17.45	1.273	8.513
Navajo	.4				
Undated	8.5				
Muhlenbergia racemosa					
LPIII	1.5	.041	100	.006	100
Mixed	.1				
Muhlenbergia sp.					
Undated	.1				
Nolina microcarpa					
MPIII	19.2	6.195	99.470	.369	98.66
LPIII	1.2	.033	.530	.005	1.34
Opuntia erinacea					
BMIII	.1				
PII	8.9	.736	2.41	.270	3.35
EPIII	41.1	7.97	26.1	2.94	36.52
MPIII	91.4	2.95	9.65	1.76	21.86
LPIII	689.7	18.90	61.85	3.08	38.26
PIII	31.5				
Navajo	2.5				
Mixed	51.1				
Undated	74.9				
Opuntia sp.					
PII	12.4	1.025	11.02	.360	16.44
EPIII	12.0	2.33	25.04	.860	39.27
LPIII	217.5	5.950	63.94	.970	44.30
PIII	.2				
Undated	92.7				
Opuntia whipplei					
PII	58.1	4.80	94.56	1.76	94.06
MPIII	4.5	.145	2.86	.090	4.81
LPIII	4.8	.131	2.580	.021	1.12

Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
Oryzopsis hymenoides					
MPIII	.5	.016	88.88	.01	96.153
LPIII	.1	.002	11.11	.0004	3.846
Pectis angustifolia					
MPIII	.2	.006	100	.0038	100
Phalaris arundinacea					
PII	.1	.008	80.0	.003	88.235
LPIII	.1	.002	20.0	.0004	11.764
Phaseolus vulgaris					
PI	.7				
PII	10.6	.876	3.3	.321	3.76
EPIII	66.7	12.93	48.60	4.76	55.80
MPIII	97.0	3.13	11.76	1.87	21.92
LPIII	353.6	9.671	36.34	1.58	18.52
PIII	.7				
Navajo	184.0				
Mixed	16.6				
Undated	23.2				
Philadelphus microphyllus					
EPIII	54.6	10.58	99.62	3.9	99.85
LPIII	1.5	.04	.38	.006	.15
Phragmites communis					
BMIII	6.0				
PI	59.6				
PII	2403.1	198.6	16.89	72.82	20.0
EPIII	2785.8	539.9	45.91	199.0	54.57
MPIII	1535.8	49.56	4.215	29.53	8.10
LPIII	14,179.9	387.85	33.0	63.30	17.36
PIII	42.8				
Navajo	26.1				
Mixed	570.9				
Undated	574.1				
Physalis sp.					
MPIII	.1	.003	3.226	.002	12.5
LPIII	3.2	.090	96.774	.014	87.5
Navajo	.1				
Mixed	.2				
Pinus edulis					
BMIII	.1				
PI	19.4				
PII	111.4	9.207	15.06	3.376	21.02
EPIII	62.4	12.09	19.77	4.457	27.75
MPIII	124.0	4.00	6.54	2.38	14.82
LPIII	1310.6	35.85	58.63	5.85	36.42
PIII	1.4				
Navajo	3.6				
Mixed	126.1				
Undated	36.2				
Pinus ponderosa					
PI	22.3				
PII	.4	.033	.991	.012	1.54
EPIII	5.2	1.008	30.29	.371	47.63
MPIII	1.6	.052	1.562	.031	4.0
LPIII	81.7	2.235	67.16	.365	46.85
Mixed	11.7				
Undated	45.2				
Pinus sp.					
PII	31.6	2.611	49.60	.957	52.6
EPIII	8.0	1.55	29.45	.571	31.3
MPIII	8.1	.261	5.00	.156	8.6
LPIII	30.8	.842	16.00	.138	17.6
Undated	13.0				
Poa fendleriana					
LPIII	.1	.002	100	.0004	100
Polypogon monspeliensis					
LPIII	.2	.005	100	.001	100
Polypogon sp.					
LPIII	.1	.002	100	.0004	100
Navajo	.1				

Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
Populus sp.					
BMIII	.7				
PI	12.2				
PII	233.3	19.28	2.37	7.07	3.22
EPIII	1357.8	263.14	32.33	96.98	44.16
MPIII	2483.8	80.15	9.85	47.77	21.75
LPIII	15,182.1	451.26	55.45	67.77	30.86
PIII	272.5				
Pseudotsuga menziesii					
MPIII	1.0	.032	100	.019	100
Undated	4.3				
Proboscidea parviflora					
LPIII	21.0	.057	100	.093	100
Prunus virens					
LPIII	17.2	.470	100	.076	100
Punky wood					
PI	369.2				
PII	526.0	43.47	15.64	15.94	17.75
EPIII	791.9	153.47	55.23	56.56	63.00
MPIII	291.9	9.42	3.39	5.61	6.25
LPIII	2614.7	71.52	25.74	11.67	13.00
PIII	8.8				
Navajo	1.2				
Mixed	102.1				
Undated	24.6				
Quercus gambellii					
MPIII	.3	.0096	2.746	.0057	9.344
LPIII	12.4	.340	97.254	.0553	90.66
Navajo	8.0				
Undated	8.6				
Quercus sp.					
EPIII	5.2	1.008	6.707	.371	13.72
MPIII	3.1	.100	.665	.060	2.22
LPIII	508.9	13.92	92.63	2.272	84.05
PIII	9.1				
Navajo	89.9				
Mixed	21.9				
Undated	5.5				
Resin					
LPIII	90.3	2.47	100	.403	100
Navajo	.5				
Mixed	14.1				
Rhus radicans					
LPIII	66.3	1.813	100	.296	100
PIII	2.4				
Navajo	.3				
Mixed	1.0				
Undated	5.4				
Rhus sp.					
PII	1.1	.091	11.1	.033	9.48
MPIII	13.9	.450	54.9	.270	77.60
LPIII	10.2	.279	34.0	.045	12.93
Undated	8.1				
Rhus trilobata					
PI	.9				
PII	327.8	27.1	25.03	9.93	24.66
EPIII	68.4	13.25	12.24	4.90	12.17
MPIII	1025.9	33.10	30.57	19.73	49.00
LPIII	1273.6	34.83	32.16	5.70	14.15
PIII	13.0				
Navajo	.1				
Mixed	15.2				
Undated	4.2				
Woody root					
PII	48.3	3.99	24.29	1.463	30.09
EPIII	24.4	4.73	28.80	1.742	35.83
MPIII	29.0	.936	5.70	.557	11.45
LPIII	247.6	6.772	41.22	1.10	22.62
PIII	18.5				
Navajo	3.3				
Mixed	3.2				
Undated	1.5				

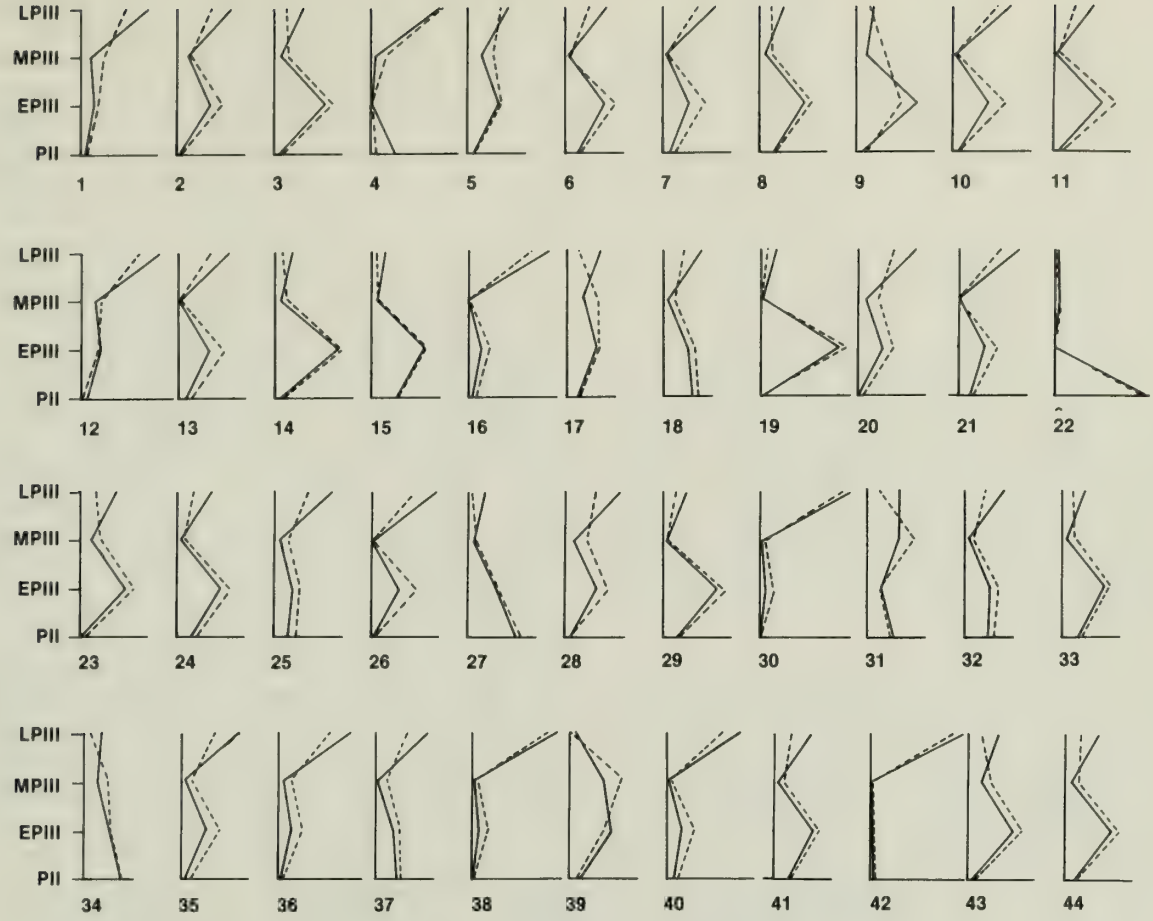
Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
Rosa sp.					
PII	18.4	1.520	88.83	.557	94.73
LPIII	7.0	.191	11.16	.031	5.27
PIII	7.4				
Salix amygdaloides					
MPIII	.3	.0096	42.48	.0057	74.03
LPIII	.5	.013	57.52	.002	25.97
Salix exigua					
MPIII	2.9	.0936	100	.0557	100
Salix laevigata					
PII	.1	.008	100	.003	100
Salix sp.					
BMIII	.2				
PI	46.6				
PII	2611.0	215.80	19.55	79.12	21.78
EPIII	2546.2	493.45	44.70	181.87	50.07
MPIII	2708.3	87.39	7.92	52.08	14.34
LPIII	11,235.4	307.31	27.84	50.16	13.81
PIII	487.2				
Navajo	14.3				
Mixed	516.4				
Undated	427.6				
Sarcobatus vermiculatus					
PI	1.6				
PII	573.5	47.40	37.07	17.38	37.64
EPIII	190.1	36.84	28.81	13.58	29.41
MPIII	576.0	18.60	14.55	11.13	24.11
LPIII	914.8	25.02	19.57	4.08	8.83
PIII	6.3				
Navajo	.7				
Mixed	17.1				
Undated	5.1				
Scirpus					
PIII	.8				
LPIII	13.0	.355	100	.058	100
Scirpus Typha					
PI	2.2				
PII	38.8	3.21	4.42	1.17	7.11
EPIII	53.8	10.43	14.40	3.84	23.33
MPIII	131.3	4.24	5.84	2.52	15.31
LPIII	2001.7	54.75	75.38	8.93	54.25
PIII	10.1				
Navajo	1.3				
Mixed	43.3				
Undated	52.5				
Sclerocactus whipplei					
PI	13.2				
PII	14.7	1.21	7.02	.445	10.06
EPIII	24.7	4.80	27.86	1.76	39.77
MPIII	27.0	.87	5.05	.52	11.75
LPIII	378.3	10.35	60.07	1.70	38.42
Navajo	4.7				
Mixed	5.0				
Undated	13.2				
Senecio longilobus					
PIII	1.8				
Setaria leucopila					
EPIII	.2	.005	27.78	.001	33.33
LPIII	.5	.013	72.22	.002	66.67
Mixed	.2				
Shepherdia rotundifolia					
PIII	.3				
Solanum sp.					
LPIII	4.2	.115	100	.019	100
Sphaeralcea fendleri					
LPIII	.1	.002	100	.0004	100
Sphaeralcea sp.					
LPIII	.7	.019	100	.003	100
Navajo	.1				

Time	Weight	Provenience Volume Adjustment*	%	Provenience Number Adjustment**	%
Sorted vegetal					
BMIII	.4				
PI	11.0				
PII	2584.4	213.59	21.33	78.31	28.61
EPIII	1023.4	198.33	19.80	73.1	26.71
MPIII	963.3	31.10	3.10	31.1	11.36
LPIII	20,417.0	558.45	55.77	91.15	33.31
Navajo	32.4				
Mixed	158.0				
Undated	525.7				
Sporobolus contractus					
LPIII	76.9	2.10	100	.343	100
Sporobolus cryptandrus					
PII	.1	.008	.022	.003	.051
LPIII	1312.5	35.90	99.97	5.86	99.95
Mixed	.5				
Sporobolus sp.					
PII	.7	.06	1.02	.021	1.90
EPIII	2.4	.465	7.91	.171	15.40
MPIII	3.1	.100	1.70	.060	5.40
LPIII	192.1	5.25	89.36	.860	77.34
Undated	1.0				
Typha latifolia					
PI	.3				
PIII	.1				
EPIII	5.4	1.05	9.42	.385	18.92
LPIII	369.1	10.09	90.60	1.650	81.08
Unknown					
PII	1.5	.124	10.10	.045	8.442
EPIII	2.7	.523	42.62	.192	36.022
MPIII	14.4	.465	37.90	.277	51.97
LPIII	4.2	.115	9.40	.019	3.60
Navajo	.2				
Verbesina enceloides					
MPIII	.1	.003	100	.001	100
Vitis arizonica					
PII	.4	.033	7.13	.012	11.88
EPIII	.4	.077	16.63	.03	29.70
MPIII	.2	.006	1.30	.003	2.97
LPIII	12.7	.347	74.94	.056	55.44
Navajo	.3				
Mixed	1.5				
Undated	.1				
Vitis sp.					
MPIII	1.1	.035	33.33	.021	65.62
LPIII	2.5	.070	66.66	.011	34.37
Wood, miscellaneous					
PI	266.4				
PII	5758.5	475.91	15.65	174.5	18.56
EPIII	6385.8	1237.55	40.70	456.1	48.52
MPIII	6651.6	214.64	7.06	127.9	13.60
LPIII	40,663.6	1112.24	36.58	181.53	19.31
PIII	546.0				
Navajo	276.7				
Mixed	1654.9				
Undated	1385.9				
Xanthium sp.					
PI	.3				
PII	2.3	.190	2.54	.070	5.26
EPIII	1.0	.194	2.59	.071	5.33
MPIII	2.1	.070	.935	.040	3.00
LPIII	257.2	7.035	93.94	1.15	86.40
Navajo	32.9				
Mixed	3.8				
Undated	2.9				
Yucca angustissima					
LPIII	.9	.025	100	.004	100
Yucca baccata					
MPIII	8.6	.277	51.39	.165	79.33
LPIII	9.6	.262	48.61	.043	20.67
Mixed	3.0				

Time	*Weight*	*Provenience Volume Adjustment**	%	*Provenience Number Adjustment***	%
Yucca sp.					
PI	22.1				
PII	999.3	82.59	8.23	30.28	9.01
EPIII	2492.2	482.98	48.15	178.01	53.00
MPIII	4039.3	130.34	13.00	77.70	23.12
LPIII	11,230.7	307.20	30.62	50.14	14.92
PIII	59.0				
Nava	22.8				
Mixed	447.5				
Undated	301.8				
Zea mays					
BMIII	.1				
PI	298.9				
PII	12,006.3	992.26	10.49	363.82	12.04
EPIII	23,655.1	4584.32	48.46	1689.65	55.92
MPIII	23,949.3	772.81	8.17	460.56	15.24
LPIII	113,700.0	3109.96	32.90	507.59	16.80
PIII	1344.5				
Nava	566.041				
Mixed	3473.627				
Undated	4622.134				

* = Volume adjusting divisor
PII = 12.2
EPIII = 5.16
MPIII = 30.99
LPIII = 36.56

** = Number adjusting divisor
PII = 33
EPIII = 14
MPIII = 52
LPIII = 224



volume adjustment

Number adjustment

H 10%

1. Cucurbitaceae
2. Acer negundo
3. Artemisia sp.
4. Chenopodium berlandieri
5. Cleome serrulata
6. Coniferous wood
7. Cucurbita pepo
8. Curcurbita sp.
9. Ephedra sp.
10. Equisetum hyemale
11. Unidentified fiber
12. Gossypuim hirsutum
13. Split woody herbs
14. Hollow woody herbs
15. Juglans sp.
16. Juniperus osteosperma
17. Juniperus sp.
18. Unidentified leaves
19. Mirabilis multiflora
20. Opuntia erinacea
21. Opuntia sp.
22. Opuntia whipplei
23. Phaseolus vulgaris
24. Phragmites communis
25. Pinus edulis
26. Pinus ponderosa
27. Pinus sp.
28. Populus sp.
29. Punky wood
30. Quercus sp.
31. Rhus trilobata
32. Woody root
33. Salix sp.
34. Sarcobatus vermiculatus
35. Sclerocactus whipplei
36. Scirpus/Typha
37. Sorted vegetal
38. Sporobolus sp.
39. Unknown
40. Vitis arizonica
41. Miscellaneous wood
42. Xanthium sp.
43. Yucca sp.
44. Zea mays

Figure 33. Macrovegetal recovery from Antelope House.

of adjustment showed the same trends and that caution would be indicated where they did not.

Table 33 lists all species identified from the macrovegetal refuse, except fungi and species introduced from Europe. The weight found in a given period is divided by each adjusting divisor, then recomputed as a percentage of the total adjusted weight in order to facilitate comparison across species represented bv very different absolute weights. Figure 33 graphs the data in Table 33 for species found in at least three of the periods from Pueblo II to Late Pueblo III and represented by more than 50 g total weight.

In spite of exceptions, the quantitative trend is clear. Early Pueblo III horizons yield an abundance of plant remains, relative to the sparse yield of Middle Pueblo III. Late Pueblo III strata provide the greatest absolute amount of plant refuse, but when the number and size of provenience is accounted for, the relative yield decreases to about that of Early Pueblo III and often to less.

The most obvious exceptions are *Chenopodium berlandieri, Opuntia whipplei, Pinus* sp., *Quercus* sp., *Sarcobatus vermiculatus, Xanthium* sp. and unidentified remains. The data for *Chenopodium* are skewed by a heavy root and stem found in a single Late Pueblo III provenience (P 1184), which accounts for more than 94 percent of the weight of the entire sample. Likewise, almost 78 percent of the total weight of *Opuntia whipplei* is from a single Pueblo II provenience (P 1561).

The other exceptions are not so readily attributed to sampling anomalies, and it seems neither necessary nor fruitful to attempt to explain them. It is perhaps worth noting, however, that the unidentified remains total only 23 g and do not, therefore, constitute a particularly large reservoir of ignorance.

We were chagrined to find that the distribution of peach remains (*Prunus persica*), principally in the form of peach pits, followed the general pattern outlined above, even before any adjustments were made (Table 34). Since this European introduction unquestionably is intrusive below Navajo strata, the situation clearly demanded investigation. Examination of peach pit proveniences, in conjunction with examination of a site map and personal communication with Don P. Morris, led to the following conclusions: peach pits appear as common intrusives principally because (1) they are hoarded away in burrows by rodents, and (2) because of their size, weight and shape, they can easily slip from higher into lower strata during excavation.

Most Pueblo I proveniences were located on that side of the site eroded away by the canyon stream, giving rodents direct lateral access to those Pueblo I proveniences which contained the pits (a cache of 27 seeds was found in P 1106, Room 70, at the eroded edge of the site). Most of the Pueblo II proveniences excavated were away from the edge and under well-sealed floors, which would inhibit later rodent burrowing. The lack of peach pits in these areas, therefore, is not surprising. Contamination of the upper Late Pueblo III proveniences was expectable. The only puzzle remaining was that of the unexpectedly large number of pits found in Early Pueblo III proveniences. Whereas peach parts were fairly evenly distributed in four separate Middle Pueblo III proveniences, those from Early Pueblo III strata were found in three groups, containing 15, five and six seeds. All were located in Kiva B Annex, an area between the pueblo proper and the alcove walls. An enormous pack rat nest discovered there (Don P. Morris 1974: personal communication) indicates that rodents must have found it particularly suitable for burrowing and for depositing their disconcerting caches.

Table 35 lists all species identified from vegetal artifacts. Table 36 shows all those species found in at least three of the last four Anasazi cultural periods and which were a part of at least 10 artifacts. The raw numbers are adjusted for provenience volume and number and quotients are converted to percentages to facilitate comparisons. Figure 34 graphs the percentaged data in Table 36.

Artifacts do not evidence a general trend in quantitative distribution of plant species through time. Instead, a number of distinct but intergrading patterns emerge. *Amelanchier utahensis, Cucurbita* sp. and *Gossypium hirsutum* repeat the pattern so common in the macrovegetal remains. *Cercocarpus* sp. and *Populus tremuloides* differ in being disproportionately underrepresented in Middle Pueblo III strata. The other species found in artifacts show less obvious patterns. Some (*Acer negundo, Fendlera rupicola, Pinus ponderosa, Quercus gambellii,* miscellaneous wood) are less abundantly represented in Early Pueblo III than in Late Pueblo III or Pueblo II layers, but not dramatically so in either case. Others (*Phragmites*

Table 34. Temporal distribution of peach parts.

Prunus persica Time	Weight (grams)	Vol. adj.	%	No. adj.	%
PI	53.0	–	–	–	–
PII	0	–	–	–	–
EPIII	73.3	13.09	48.53	5.235	66.13
MPIII	22.7	.073	.27	.436	5.51
LPIII	504.9	13.81	51.20	2.245	28.36
PIII	4.7	–	–	–	–
Navajo	290.3	–	–	–	–
Mixed	9.8	–	–	–	–
Undated	1.1	–	–	–	–

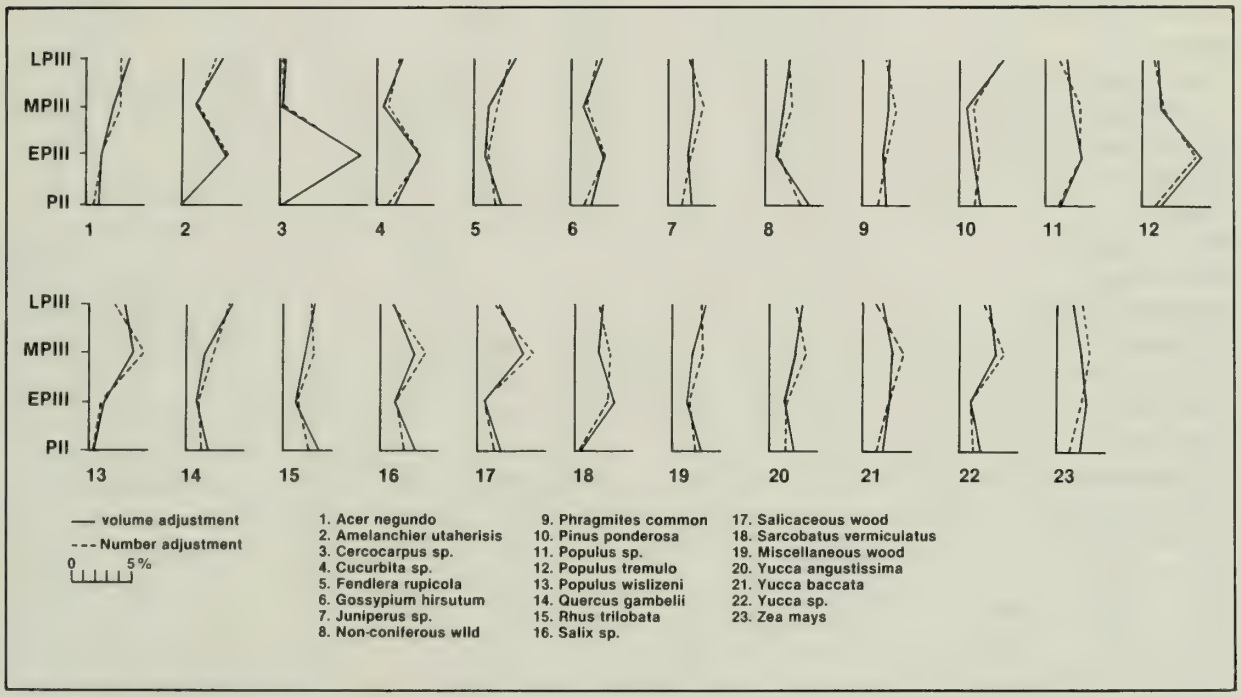


Figure 34. Distribution of plant species in vegetal artifacts.

communis, *Juniperus* sp., *Zea mays*) show little change through time. Others approximate one or more of the above patterns. In short, if the microvegetal remains are thought to reflect a pattern of environmental change, then the species composition of vegetal artifacts seems more strongly influenced, in general, by factors other than the mere availability of the plants used in artifacts.

The exceptions to this generalization have already been noted. *Cucurbita* and *Gossypium* are both cultivars, of course, and it appears that their use in artifacts depended upon their availability and ultimately, therefore, upon agricultural conditions. *Amelanchier utahensis*, and perhaps *Sarcobatus vermiculatus*, also demonstrates a trend of use dependent upon availability. Such a trend can indicate at least two exploitative strategies: (1) a particular plant might be exploited almost to its limit, or (2) certain artifacts might be made with whatever plant was usable and handy. Overuse, of course, ultimately would deplete a given resource, in which case climatic fluctuations would not be reflected in its artifactual use. I did not attempt to ascertain which, if either, of these two possibilities is the most plausible in

Table 35. Number of vegetal artifacts in which listed plant species occur, through time.

Species	*undated*	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*PIII*	*Mixed*	*Navajo*
Acer negundo	22	—	3	5	15	81	2	9	—
Agropyron trachycalum	—	—	—	—	1	—	—	—	—
Agrostis exarata	—	—	—	—	—	1	—	—	—
Alnus oblongifolia	—	—	—	—	—	3	—	—	—
Amaranthus blitoides	—	—	1	1	—	1	—	—	—
Amaranthaceae/Chenopodiaceae	—	—	—	—	—	1	—	—	—
Amelanchier utahensis	4	—	—	2	1	11	—	1	—
Apocynum sp.	—	—	—	—	—	4	—	—	1
Artemisia bigelovii	1	—	—	—	—	—	—	—	—
Artemisia ludoviciana	—	—	—	—	—	3	—	—	—
Artemisia sp.	—	—	—	—	—	2	—	—	—
Artemisia tridentata	—	—	1	—	—	3	—	—	—
Aster foliaceus	—	—	—	—	1	—	—	—	—
Atriplex canescens	—	—	—	—	—	2	—	—	—
Atriplex jonesii	—	—	—	—	—	—	1	—	—
Atriplex sp.	—	—	—	—	—	1	—	—	—
Betula occidentalis	—	—	—	—	—	1	—	—	—
Caprifoliaceae	—	—	—	—	—	1	—	—	—
Cercocarpus montanus	—	—	—	—	—	2	—	—	—
Cerocarpus sp.	3	2	1	29	3	14	—	—	1
Chenopodium berlandieri	1	—	—	—	—	—	—	—	—
Cleome serrulata	1	—	—	—	1	1	—	—	—
Compositae	—	—	—	—	—	2	—	—	—
coniferous wood	—	—	—	—	1	2	—	—	—
Cowania mexicana	—	—	—	—	—	1	—	—	—
Cucurbita pepo	2	—	—	—	—	—	—	—	—
Cucurbita sp.	3	—	1	3	1	11	—	2	—
Cycloloma atriplicifolium	—	—	1	—	—	—	—	—	—
Eragrostis diffusa	—	—	—	—	—	1	—	—	—
Eriogonum simpsonii	—	—	—	—	1	2	—	—	—
Eriogonum sp.	—	—	—	—	—	1	—	—	—
Ephedra sp.	1	—	—	—	—	—	—	—	—
Eurotia lanata	—	—	—	—	—	1	—	—	—
Fendlera rupicola	10	—	3	2	4	35	—	5	—
Glyceria striata	—	—	1	—	1	—	—	—	—
Gossypium hirsutum	38	—	5	10	28	74	1	4	2
Gramineae	—	—	—	—	—	5	—	—	—
Helianthus sp.	2	—	—	—	1	2	—	—	—
split woody herbs	1	—	1	—	1	4	—	1	—
Juglans major	1	—	1	1	—	5	—	—	—
Juniperus scopulorum	—	—	1	—	—	3	—	—	—
Juniperus osteosperma	1	—	—	—	—	1	—	—	—
Juniperus sp.	13	1	4	5	12	38	1	1	—
Lagenaria siceraria	3	—	—	—	3	5	—	—	—
Lesquerella intermedia	—	—	—	—	—	2	—	—	—
Muhlenbergia asperifolia	—	—	—	1	—	—	—	—	—
Muhlenbergia racemosa	1	—	—	—	1	2	—	—	—
Nolina microcarpa	—	—	—	—	—	3	—	—	—

Species	*undated*	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*PIII*	*Mixed*	*Navajo*
nonconiferous wood	3	—	3	1	3	14	—	—	—
Pectis angustifolia	—	—	—	—	1	—	—	—	—
Philadelphus microphyllus	4	—	—	—	7	15	—	—	—
Phragmites communis	73	2	18	23	53	184	2	27	1
Pinus edulis	3	—	—	1	—	1	—	—	—
Pinus ponderosa	7	—	1	1	1	17	—	—	—
Pinus sp.	—	—	—	—	—	1	1	1	—
Poa fendleriana	—	—	1	—	—	—	—	—	—
Poliomeintha incana	—	—	—	—	—	1	—	—	—
Populus acuminata	—	—	—	1	1	—	—	—	—
Populus angustifolia	1	—	—	—	—	—	—	—	—
Populus sp.	29	2	11	28	39	103	6	1	—
Populus tremuloides	16	—	7	29	16	45	—	10	3
Populus wislizenii	20	1	1	3	18	48	1	5	1
Portulaca retusa	—	—	1	—	—	—	—	—	—
Prunus sp.	—	—	—	—	—	—	—	1	—
Quercus gambelii	7	—	3	2	7	57	1	—	—
Quercus turbinella	1	—	1	2	—	4	—	—	—
Quercus sp.	—	—	2	—	1	4	—	—	—
Rhus trilobata	28	2	10	5	15	76	—	11	—
Rumex hymenosepalus	—	—	—	—	—	2	—	—	—
Salix amygdaloides	1	1	1	—	—	7	—	—	—
Salix exigua	7	—	—	—	12	21	—	1	—
Salix laevigata	—	—	—	—	1	1	—	—	—
Salix sp.	44	4	49	28	114	146	—	19	1
salicaceous wood	12	—	2	1	10	16	1	6	1
Sarcobatus vermiculatus	33	1	4	21	30	120	—	3	—
Scirpus americanus	1	—	—	—	1	1	—	—	—
Scirpus/Typha	1	—	—	—	1	5	—	—	—
Senecio sp.	1	—	—	1	—	1	—	—	—
Sphaeralcea fendler/parviflora	—	—	—	1	—	—	—	—	—
Sporobolus contractus	—	—	—	—	1	3	—	1	—
Tetradymia canescens	—	—	—	1	—	—	—	—	—
miscellaneous wood	21	—	4	3	7	37	—	4	—
Yucca angustissima	43	1	9	8	25	100	—	9	1
Yucca baccata	70	1	19	33	68	151	—	13	2
Yucca sp.	17	—	3	2	12	34	1	3	—
Zea mays	70	2	16	28	49	204	2	10	1

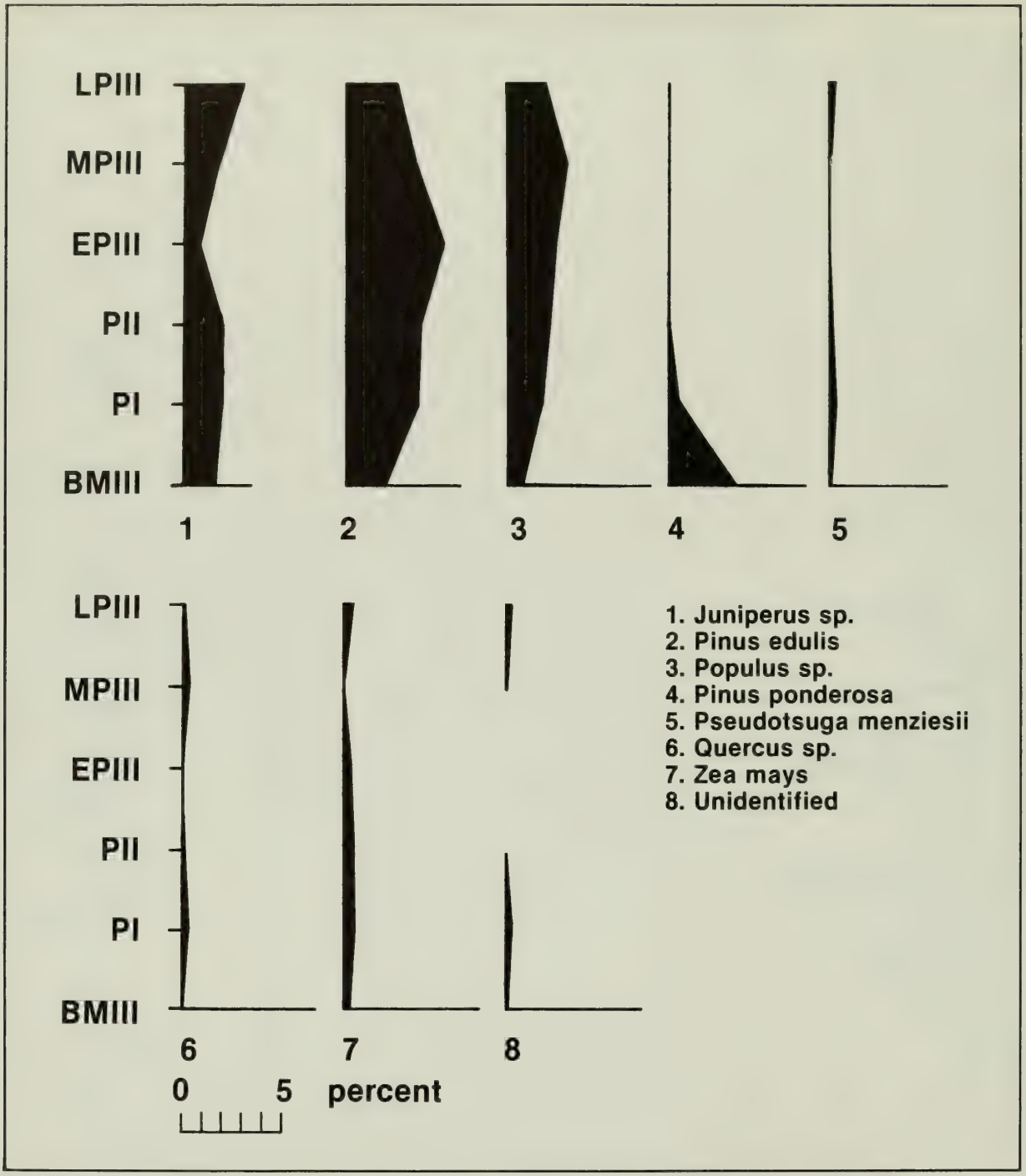


Figure 35. Percentage of use of a species as charcoal, by period (adjusted to provenience numbers).

the cases noted above; I mention it merely as an area suitable for further research.

As *Populus tremuloides* grows only in cooler, wetter environments, its disproportionate presence in Early Pueblo III artifacts (principally as bark) may indicate unusual accessibility, quite in accordance with what would be expected of a fast-growing tree expanding its range in a favorable environment.

As the data in Appendix G demonstrate, *Cercocarpus* sp. is found in unusual abundance during Early Pueblo III times because of its increased use in arrowshafts. The common species in the canyon system today is *C. intricatus*, the angular branches of which are not suitable for such use. The presently uncommon *C. montanus* has stems more suited to the manufacture of arrows. As *C. montanus* prefers wetter habitats than does *C. intricatus*, the presence of *Cercocarpus* arrowshafts in the Early Pueblo III artifactual array is taken to imply the easy availability of *C. montanus* and, by extension, a wetter environment than that of the present.

The increased proportion in Middle Pueblo III artifacts of *Populus wislizenii*, *Salix* sp. and other salicaceous woods seems puzzling in view of the macrovegetal data for *Salix* and *Populus* (Table 33 and Fig. 33), which exhibit a pattern of decreased abundance during Middle Pueblo III. Discrepancies of this sort are to be expected, however, in the complex interplay between culture and environment. One factor in plant use is availability, but others include cultural preferences, the suitability of the plant for the purpose at hand, the time lag between conditions favorable to seedling germination and the harvestable stage of the plant, and differences in behavior during times of plenty and during times of scarcity. The reader will have no trouble inferring a combination of circumstances to account for the data in question: (1) increased seedling germination during Early Pueblo III times, due to a wetter climate, (2) salicaceous plants ready for harvesting during Middle Pueblo III times, and (3) generation of much more refuse when times were fat than when they were lean. Whether such speculations are well founded is beyond the scope of this analysis. The material excavated from Antelope House, however, may hold the answer for a future researcher.

Table 37 records the distribution of charcoal for the entire site. The great majority of this material is from hearths, but the numerous *Pinus ponderosa* fragments from a Basketmaker III provenience represent the burned timbers of a pit structure. The provenience volume adjustment has been calculated for the last four Anasazi periods; the provenience number adjustments have been computed for Basketmaker III and Pueblo I times. The last two columns in Table 37 represent the percentage of a species in a given cultural period, relative to all species used at that time, adjusted by provenience volume and number, respectively. Figure 35 illustrates the provenience number adjusted percentages. The burned Basketmaker timbers produce an anomaly in that period, but the rest of the data show that *Juniperus*, *Pinus edulis* and *Populus* were the most common firewoods. Pinyon predominates, which agrees with the thesis that it was favored as firewood for its fragrance, intense heat, slow burning and lack of smoke (Robinson 1967: 72). Vestal (1952: 13) and Ford (1968: 28) document ethnographic preferences and use of pinyon as fuel for open fireplaces.

The percentage of *Populus* charcoal reaches a maximum in Middle Pueblo III proveniences, which agrees with the maximum use of *Populus* in artifacts. Juniper in charcoal reaches its lowest percentage in Early Pueblo III proveniences, perhaps indicating that it was used relatively less when a better fuel (i.e., pinyon) was more readily available. Besides the difference in the way pinyon and juniper burn, casual observation suggests that pinyon also is easier to collect than is juniper.

Figure 36 illustrates the percentage of each of the three major fuels used at each period, relative to the use of that species throughout the graphed interval. Percentages based on numbers adjusted for provenience volume are computed from Pueblo II through Late Pueblo III and percentages based on numbers adjusted for provenience number are computed back to Basketmaker III times. *Juniperus* charcoal shows a relative increase in Late Pueblo III proveniences, while both *Pinus edulis* and *Populus* decrease, perhaps due to the overuse of the better or more accessible fuels. Otherwise, all three show much the same pattern, with a relative peak in Pueblo II proveniences and lows in Pueblo I and Early Pueblo III. Table 38 shows the dates of archeological periods at Antelope House, as determined by dendrochronological and archeomagnetic techniques. The interval of years spanned by each pair of dates, recomputed as percentages of

Table 36. Adjusted number of vegetal artifacts in which listed plant species occur.

	#	Vol. Adj.*	%	# Adj.**	%	#	Vol. Adj.	%	# Adj.	%
Acer negundo						*Amelanchier utahensis*				
PII	3	.210	13.4	.081	9.1	0	0	0	0	0
EPIII	5	.259	16.5	.152	17.1	2	.104	46.4	.061	47.7
MPIII	15	.419	26.7	.326	36.6	1	.028	12.5	.022	17.2
LPIII	81	.680	43.4	.331	37.2	11	.092	41.1	.045	35.2
Cercocarpus sp.						*Cucurbita* sp.				
PII	1	.070	4.0	.027	2.6	1	.070	20.2	.027	14.6
EPIII	29	1.50	84.7	.879	85.5	3	.156	45.1	.091	49.2
MPIII	3	.084	4.7	.065	6.3	1	.028	8.1	.022	11.9
LPIII	14	.118	6.7	.057	5.5	11	.092	26.6	.045	24.3
Fendlera rupicola						*Gossypium hirsutum*				
PII	3	.210	29.2	.081	21.8	2	.140	22.4	.054	16.2
EPIII	2	.104	14.4	.061	16.4	4	.208	33.3	.121	36.2
MPIII	4	.112	15.6	.087	23.4	3	.084	13.4	.065	19.5
LPIII	35	.294	40.8	.143	38.4	23	.193	30.9	.094	28.1
Juniperus sp.						nonconiferous wood				
PII	4	.280	23.5	.108	16.0	3	.210	45.3	.081	34.8
EPIII	5	.259	21.7	.152	22.5	1	.052	11.2	.030	12.9
MPIII	12	.335	28.1	.261	38.6	3	.084	18.1	.065	27.9
LPIII	38	.319	26.7	.155	22.9	14	.118	25.4	.057	24.5

(continued)

the total span of pre-Navajo occupation, yields a profile very similar to that for charcoal distribution (Fig. 36). The most obvious inference from this congruence is that the site yields amounts of hearth charcoal which are relatively constant through time and which are, therefore, distributed in proportion to intervals of occupation. Had there been marked changes in population numbers from period to period, the congruence of pattern probably would not obtain; from this observation, I infer that there was little change in population density during the Anasazi occupation of Antelope House. The alternative to that hypothesis demands too nice an adjustment between numbers of occupants and intervals of occupation to be at all credible.

Discussion

Although the pattern of change in the vegetal refuse at Antelope House might theoretically be explained by a parallel pattern of change in population density, the evidence suggests a steady but slight increase of population at the site from Early to Late Pueblo III. That earlier periods contained relatively more plant materials than did later ones argues against differential preservation as a significant factor. Assuming no behavioral change of sufficient magnitude to have generated that pattern, I conclude that the macrovegetal remains reflect the following environmental conditions: a very favorable period for vegetation (including cultivars) during Early Pueblo III; and a period of stress during Middle Pueblo III and another favorable period during the Late Pueblo III occupation, although the climate was not as benign during this period as during the Early Pueblo III interval.

Independent confirmation of the hypotheses was sought from other sources. Climatic inferences for the region, made on the basis of tree ring data, provided convincing evidence that the macrovegetal remains reflect climatic fluctuations. William J. Robinson and Jeffrey S. Dean, in their study of the paleoclimate of the southwestern United States, have developed computer mapping programs that plot significant departures from average tree-growth values, which are directly related to precipitation. Within the period AD 1000 to 1200, they find four periods

Table 36. Adjusted number of vegetal artifacts in which listed plant species occur—Continued

	#	Vol. Adj.*	%	# Adj.**	%	#	Vol. Adj.	%	# Adj.	%
Phragmites communis						*Pinus ponderosa*				
PII	18	1.261	23.0	.486	15.7	1	.070	23.9	.027	18.2
EPIII	23	1.194	21.8	.697	22.6	1	.052	17.7	.030	20.3
MPIII	53	1.481	27.0	1.152	37.3	1	.028	9.6	.022	14.9
LPIII	184	1.545	28.2	.751	24.3	17	.143	48.8	.069	46.6
Populus sp.						*Populus tremuloides*				
PII	11	.770	18.4	.297	12.3	7	.490	20.1	.189	11.8
EPIII	28	1.453	34.8	.848	35.1	29	1.50	61.6	.879	54.9
MPIII	39	1.090	26.1	.848	35.1	16	.447	18.3	.348	21.8
LPIII	103	.865	20.7	.420	17.4	45	.378	15.5	.184	11.5
Populus wislizenii						*Quercus gambelii*				
PII	1	.070	6.2	.027	3.8	3	.210	21.2	.081	15.4
EPIII	3	.156	13.8	.091	12.9	2	.104	10.5	.061	11.6
MPIII	18	.503	44.4	.391	55.5	7	.196	19.8	.152	28.8
LPIII	48	.403	35.6	.196	27.8	57	.479	48.4	.233	44.2
Rhus trilobata						*Salix* sp.				
PII	10	.700	34.7	.270	25.5	49	3.431	36.9	1.324	25.2
EPIII	5	.259	12.8	.152	14.4	28	1.453	15.6	.848	16.2
MPIII	15	.419	20.8	.326	30.8	114	3.185	34.3	2.478	47.2
LPIII	76	.638	31.6	.310	29.3	146	1.226	13.2	.596	11.4
Salicaceous wood						*Sarcobatus vermiculatus*				
PII	2	.140	23.1	.054	14.8	4	.280	7.8	.108	5.7
EPIII	1	.052	8.6	.030	8.2	21	1.471	40.9	.636	33.7
MPIII	10	.279	46.1	.217	59.3	30	.838	23.3	.652	34.6
LPIII	16	.134	22.1	.065	17.8	120	1.008	28.0	.490	26.0
wood, miscellaneous						*Yucca angustissima*				
PII	4	.280	29.7	.108	21.5	9	.630	24.4	.243	16.9
EPIII	3	.156	16.5	.091	18.1	8	.415	16.1	.242	16.9
MPIII	7	.196	20.8	.152	30.3	25	.699	27.1	.543	37.8
LPIII	37	.311	33.0	.151	30.1	180	.840	32.5	.408	28.4
Yucca baccata						*Yucca* sp.				
PII	19	1.331	21.4	.514	14.2	3	.210	22.5	.081	14.9
EPIII	33	1.713	27.6	1.00	27.7	2	.104	11.1	.061	11.3
MPIII	68	1.900	30.6	1.478	41.0	12	.335	35.8	.261	48.2
LPIII	151	1.268	20.4	.616	17.1	34	.286	30.6	.139	25.6
Zea mays										
PII	16	1.120	23.5	.432	13.6					
EPIII	28	1.453	30.4	.848	26.7					
MPIII	49	1.369	28.7	1.065	33.5					
LPIII	204	.833	17.4	.833	26.2					

	PII	EPIII	MPIII	LPIII
* Provenience volume adjusting divisor:	14.28	19.27	35.79	119.07
**Provenience number adjusting divisor:	37	33	46	245

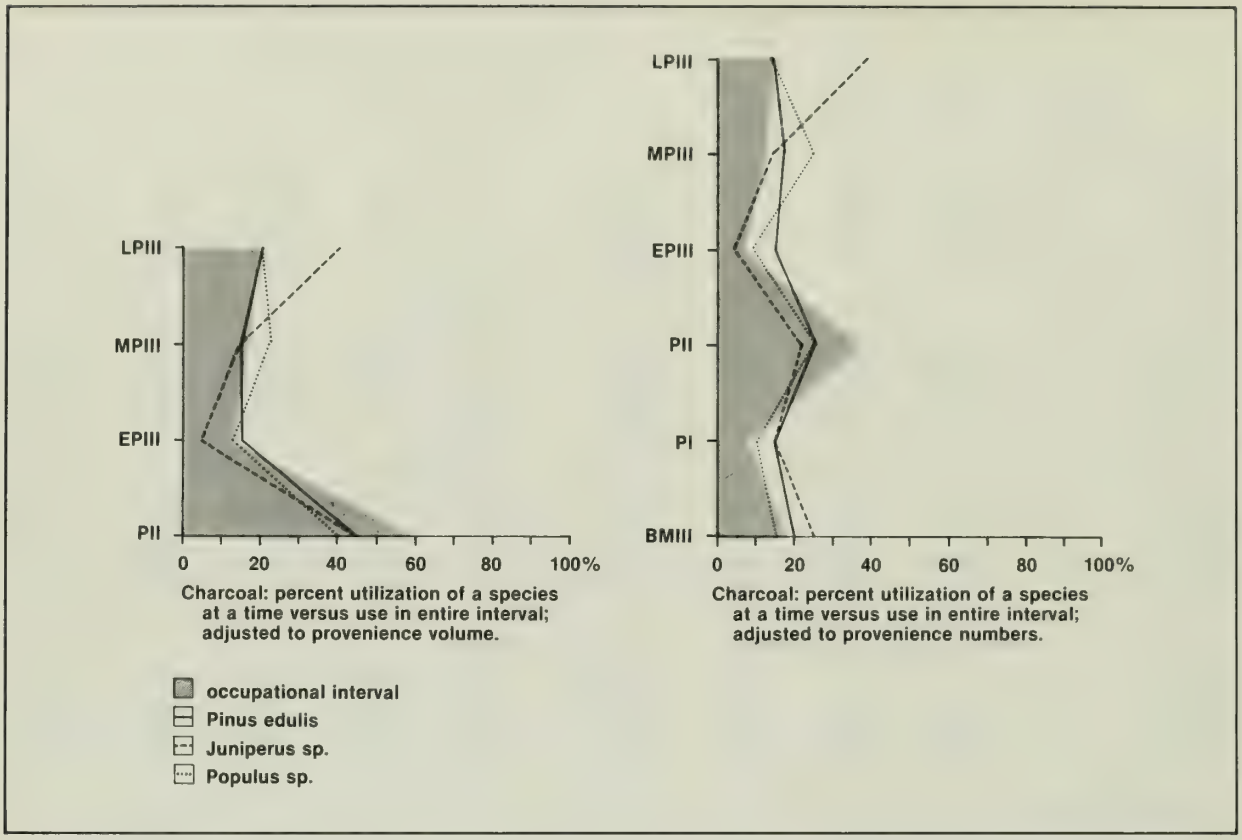


Figure 36. Percentage of use of three major fuels by period, relative to use of each species throughout the graphed interval.

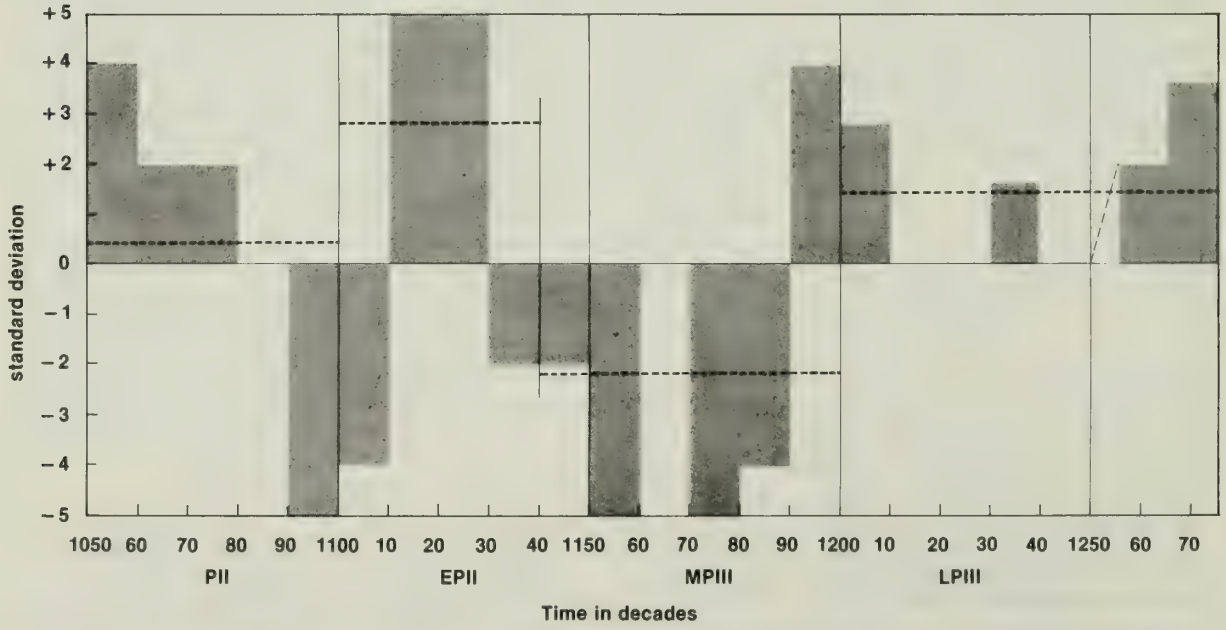


Figure 37. Climatic variations from the mean for the Four Corners area, based on tree-ring chronologies (standard deviations).

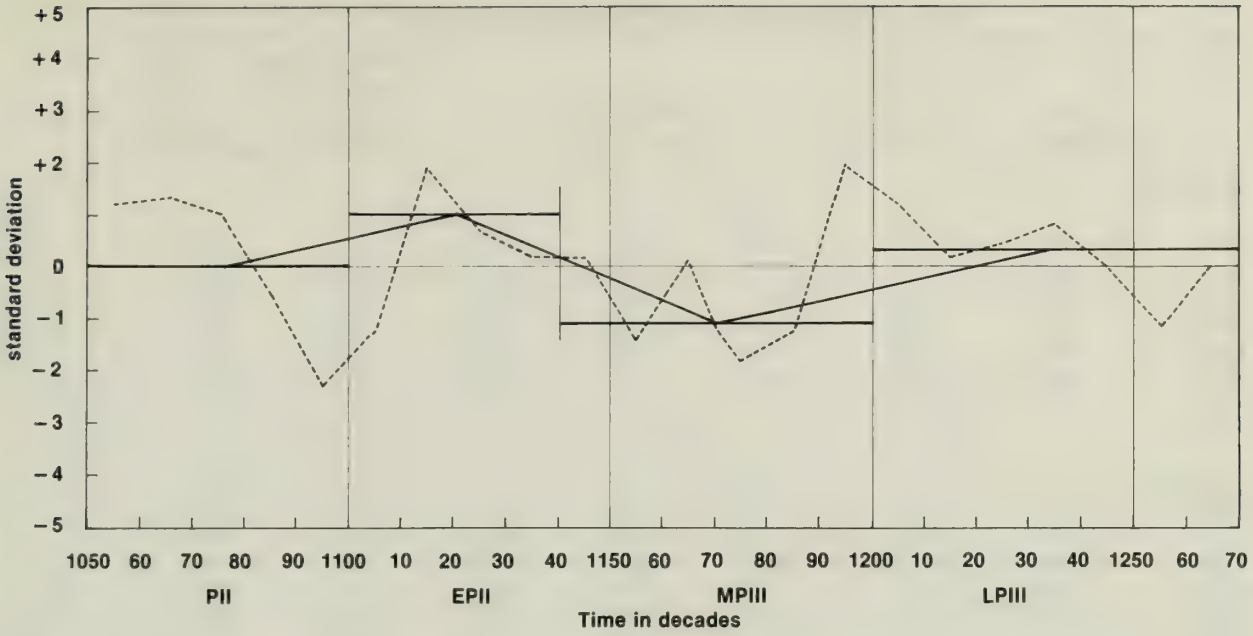


Figure 38. Climatic variations from the mean for the Canyon de Chelly area, based on tree-ring chronologies (standard deviations).

showing 20 years or more of consistent departures from the average, increased precipitation from 1110 to 1129 (which comprises the middle half of Early Pueblo III), and decreased precipitation in the following three intervals: 1030–1049 (in Pueblo II times), 1090–1109 (the initial quarter of Early Pueblo III occupation), and 1140–1189 (the initial 83 percent of Middle Pueblo III). The last interval, in fact, is characterized as one of extremely dry conditions (Robinson and Dean 1969: 7). Dean and Robinson (1977) provide additional maps and data for the interval 680–1970, with significant departures in terms of standard deviations from the long-term means plotted and contoured at 10-year intervals.

In order to convert the tree-ring data to the degree of coarseness of the macrovegetal analysis, the standard deviation for each Anasazi period from Pueblo II to Late Pueblo III was calculated by Dean and is plotted in Figure 37. The general pattern of change in precipitation is remarkably congruent with that of macrovegetal variation: marked increase during Early Pueblo III, a significant decrease during Middle Pueblo III, and an increase in Late Pueblo III.

When Figure 38 is compared with Figure 37, an interesting discrepancy appears in a generally similar pattern of change: from AD 1250 to 1274, the canyon seems to have suffered relatively dry weather, while northeastern Arizona experienced increased precipitation. This suggests that at the time drought was depleting the plant cover in the monument area, orographic rains in the Chuska Mountains were pouring floods down the canyons, cutting away at unprotected banks and fields in an ever-worsening episode of destructive erosion. The devastating impact of erosion upon an economy based on floodwater farming has been detailed by Bryan (1954), Hack (1942) and Bradfield (1971). The fields wash away and the water table is lowered; at Antelope House, there is the possibility that the site itself was partly eroded away in Late Pueblo III times. No post-Anasazi deposits possess the truncated character which would result had it originally been distributed over an area more extensive than that present today. For example, the thick layers of sheep dung from Navajo herds show no sign of having been partly destroyed at the current erosion line; instead, their distribution suggests deposition within the modern contours of the site.

But even if the village itself were untouched, the agriculture on which it depended would have been made more difficult. Earlier decades had seen heavier rains and worse droughts, but the

Table 37. Charcoal recovered, by species and period

	# of pieces	prov. vol. adj.*	%	prov. # adj.**	%	% use (compared to all species at a given time) vol. adjusted	no. adjusted
Juniperus sp.							
BMIII	22	—	—	.846	26.4	—	19.5
PI	64	—	—	.379	11.8	—	20.7
PII	76	1.742	43.0	.673	21.0	22.8	22.8
EPIII	6	.180	4.4	.105	3.3	8.7	8.7
MPIII	66	.585	14.4	.455	14.2	19.7	19.6
LPIII	395	1.545	38.1	.751	23.4	35.2	35.2
PIII	6	—	—	—	—	—	—
Navajo	8	—	—	—	—	—	—
Pinus edulis							
BMIII	26	—	—	1.000	18.6	—	23.0
PI	127	—	—	.751	13.9	—	41.1
PII	147	3.37	46.9	1.301	24.2	44.1	44.2
EPIII	41	1.23	17.1	.719	13.3	59.4	59.4
MPIII	138	1.22	17.0	.952	17.7	41.1	41.1
LPIII	349	1.37	19.1	.663	12.3	31.2	31.1
PIII	4	—	—	—	—	—	—
Navajo	15	—	—	—	—	—	—
Populus sp.							
BMIII	11	—	—	.423	13.2	—	9.7
PI	62	—	—	.367	11.4	—	20.1
PII	85	1.95	42.1	.752	23.4	25.5	25.5
EPIII	20	.60	13.0	.351	10.9	29.0	29.0
MPIII	119	1.05	22.7	.821	25.5	35.4	35.4
LPIII	263	1.03	22.2	.500	15.6	23.5	23.5
PIII	2	—	—	—	—	—	—
Navajo	28	—	—	—	—	—	—
Pinus ponderosa							
BMIII	46	—	—	1.769	93.3	—	40.7
PI	16	—	—	.095	5.0	—	5.2
PII	0	0	0	0	0	0	0
EPIII	0	0	0	0	0	0	0
MPIII	1	.009	15.0	.007	0.4	0.3	0.3
LPIII	13	.051	85.0	.025	1.3	1.2	1.2
PIII	1	—	—	—	—	—	—
Navajo	1	—	—	—	—	—	—
Pseudotsuga menziesii							
BMIII	3	—	—	.115	41.8	—	2.6
PI	9	—	—	.053	19.3	—	2.9
PII	4	.092	38.2	.035	12.7	1.2	1.2
EPIII	0	0	0	0	0	0	0
MPIII	0	0	0	0	0	0	0
LPIII	38	.149	61.8	.072	26.2	3.4	3.4
PIII	0	—	—	—	—	—	—
Navajo	1	—	—	—	—	—	—

continued

Table 37. Charcoal recovered, by species and period—Continued

	# of pieces	prov. vol. adj.*	%	prov. # adj.**	%	% use (compared to all species at a given time) vol. adjusted	no. adjusted
Quercus sp.							
BMIII	1	—	—	.038	16.4	—	0.9
PI	9	—	—	.053	22.8	—	2.9
PII	3	.069	28.6	.026	11.2	0.9	0.9
EPIII	0	0	0	0	0	0	0
MPIII	12	.106	44.0	.083	35.8	3.6	3.6
LPIII	17	.067	27.8	.032	13.8	1.5	1.5
PIII	0	—	—	—	—	—	—
Navajo	0	—	—	—	—	—	—
Zea mays							
BMIII	3	—	—	.115	23.8	—	2.6
PI	18	—	—	.107	22.2	—	5.9
PII	18	.413	67.7	.159	32.9	5.4	5.4
EPIII	2	.060	9.8	.035	7.2	2.9	2.9
MPIII	0	0	0	0	0	0	0
LPIII	35	.137	22.5	.067	13.9	3.1	3.1
PIII	0	—	—	—	—	—	—
Navajo	3	—	—	—	—	—	—
Unidentified							
BMIII	1	—	—	.038	45.8	—	0.9
PI	4	—	—	.024	28.9	—	1.3
PII	0	0	0	0	0	0	0
EPIII	0	0	0	0	0	0	0
MPIII	0	0	0	0	0	0	0
LPIII	11	.043	100	.021	25.3	1.0	1.0
PIII	0	—	—	—	—	—	—
Navajo	0	—	—	—	—	—	—

*provenience volume adjusting divisors
PII — 43.62
EPIII — 33.29
MPIII — 112.81
LPIII — 255.64

**provenience number adjusting divisors
BMIII — 26
PI — 169
PII — 113
EPIII — 57
MPIII — 145
LPIII — 526

Table 38. Intervals of occupation at Antelope House.

Period	Site occupation	Interval (yrs)	% (PII-LPIII)	% (BMIII-LPIII)
Basketmaker III	690—770	80	—	16.5
Pueblo I	809—840	31	—	6.4
Pueblo II	900—1100	200	53.3	41.2
Early Pueblo III	1100—1140	40	8.2	10.7
Middle Pueblo III	1140—1200	60	12.3	16.0
Late Pueblo III	1200—1275	75	15.4	20.0

Table 39. Habitats of species found only archeologically at Canyon de Chelly National Monument.

Period	*Species*	*Habitat**
PI	*Allium macropetalum*	dry plains amd hills
PII	*Phalaris arundinacea*	moist places, marshes, river bamks, wet meadows amd along ditches
EPIII	*Abies lasiocarpa*	cool, moist, moumtainous sites
MPIII	*Aster foliaceus*	coniferous forest amd mountaim meadows
	Pectis angustifolia	dry, sandy or gravelly mesas
LPIII	*Allium macropetalum*	dry plains amd hills
	Cycloloma atriplicifolium	sandy fields, weedy
	Eragrostis diffusa	sandy open ground along streams and washes, and in woodland and forest openings, disturbed loamy soils near roads, fields and streams
	Phalaris arundinacea	moist places, marshes, river banks, wet meadows and along ditches
	Poliomintha incana	sandy deserts, on gypsum hills and flats, eroded slopes and in sandy soil
	Proboscidea parviflora	plains, mesas and roadsides
	Setaria leucopila	rocky soil; dry plains and upland slopes, especially abundant along streambeds
	Sporobolus contractus	dry mesas, bluffs and sand hills
Mixed (mainly) PIII)	*Artemisia filifolia*	loose, sandy soil
	Shepherdia rotundifolia	steep slopes, sides of mesas and badly gullied areas
	Sporobolus asper	
red, sand loam, moist sandy soil, often weedy, in a variety of circumstances		

*From Kearney amd Peebles (1960), Gould (1951), Correll and Johnston (1970), and Harrington (1954)

people at Antelope House had never before faced this particular combination of conditions. In this, they were not alone. Bryan (1954), Hack (1942) and Reed (1944) have demonstrated that arroyo-cutting was widespread in late Pueblo III times. They argue that it was the principal cause for the abandonment of many prehistoric sites.

Table 39 lists, by period of provenience in which each was found and with a summary of each species' typical habitats, those species found only in archeological context at the monument. Especially noteworthy is that almost half of the species found in Late Pueblo III and mixed proveniences are characterized as occurring typically in disturbed soils. Although both tilled fields and eroded gullies constitute disturbed soils, the weeding of fields is a conscious effort to decrease the numbers of unwanted species; given that approximately an equal acreage is maintained under cultivation, the chances of weedy species finding their way into archeological debris increase when they grow away from the fields. An increase in weed species without an increase in agricultural area implies abandonment or erosion or both.

In addition to the evidence from tree-rings and alluvial geology, palynological evidence is consistent with the hypothesis of a late Pueblo III period of erosion. Unfortunately, the pollen chronology is not sufficiently fine-grained to corroborate that thesis. Hevly (1964) interprets the fossil pollen record from archeological sites in east-central Arizona as reflecting vegetation changes of two superimposed types. Fluctuations in the relative abundance of arboreal pollen and changing proportions of *Pinus* to *Juniperus* pollen indicate decreased effective moisture between AD 1100 and 1300. Changing proportions of large to small *Pinus* pollen indicate a shift, beginning between AD 900 and 1100 and continuing until some time between 1300 and 1800, from biseasonal to summer dominant precipitation. Arroyo-cutting, which is caused by the intense convectional storms of summer, rather than by winter's widespread drizzles, requires that the drainage channel be thoroughly moist (Martin 1963: 3). Since saturation of the channel can be due to flow from distant parts of the watershed, arroyo-cutting does not, by itself, imply rain in the immediate vicinity of Antelope House.

It is well known that runoff increases with decreased vegetative cover; therefore, if the discrepancy in the tree-ring record between Canyon de Chelly and northeastern Arizona is not specious, all the evidence suggests that conditions for erosion at Antelope House were optimal at about the time of abandonment.

LeMarche (1974) reports evidence that the entire northern hemisphere's climate from AD 1000 to AD 1200 consisted of warm-moist and warm-dry periods similar to those of the recent past, followed by a long–term cooling trend beginning in the 13th century. This cooling trend, in conjunction with the oft-invoked "Great Drought" of the late 1200's, may well explain the population shift in the aboriginal Southwest, but the abandonment of Antelope House may have been precipitated by earlier, probably more dramatic climatic events, which resulted in severe erosion of the site. If this is so, it is probable that the occupants of Antelope House moved upstream, to a site where they could continue the floodplain farming to which they were accustomed. Such a pattern of settlement and mobility based on climatic exigencies has been modeled by Schoenwetter and Eddy (1964: 128), Cordell (1975) and Schwartz (1957) and has been discussed at some length by Schoenwetter and Dittert (1968). An archeological survey of Canyon de Chelly could test this hypothesis and perhaps could locate sites likely to shed more light on why the area was abandoned.

The following is a final observation on the appropriateness of using vegetal remains as an index to the past climate of an archeological site. The validity of the conclusions drawn here rest largely on the assumption that human intervention did not cause major distortions in the vegetation of the area under study, so that fluctuations in archeological species composition and frequency are caused primarily by fluctuations in the natural vegetation and, by extension, in the climate. The agreement between the macrovegetal evidence and other sources of paleoclimatic evidence support that assumption, but there also is ethnographic evidence to corroborate it. In his study of San Juan Pueblo, Ford (1968) notes that semi-cultivated and wild plants are collected in a way which allows them to replace their populations the following year. This holds true for the gathering of greens and edible fruits, in the selection of bulbs, in the collection of medicinal plants, in the randomizing of areas of collection, in the use of only certain portions of plants for making artifacts and in the use of only dead cottonwoods and dead pinyon branches for firewood (Ford 1968: 191–205). In short, he documents an ethic of selective exploitation, a conscious effort to conserve resources in order to insure sustained productivity. The data from Antelope House suggest this was a fruitful ethic in a land of limited and uncertain bounty.

Summary and Conclusions

Faunal material recovered from Antelope House suggested the desirability of analyzing the vegetal remains in order to attempt a climatic reconstruction for the period of Anasazi occupation. A statistical comparison of the elevational ranges of archeological and modern plant species indicated hotter and drier conditions than the present one. This finding is in partial accord with LeMarche's (1974: 1043) conclusion that "the period from about AD 1000 to AD 1200 was apparently the warmest period in temperate latitudes of the Northern Hemisphere in the millennium prior to AD 1850."

When adjusted to account for differences in sampling different cultural periods, the amount of vegetal refuse shows a pattern of variation congruent with paleoclimatic fluctuations as recorded by tree-rings and pollen profiles. This pattern is interpreted as evidence that climatic conditions generally were favorable for agriculture prior to 1100, very favorable (on the average) from 1100 to 1140, unfavorable from 1140 to 1200 and again favorable from 1200 to 1250. It is hypothesized that drought in the canyon after about 1250, combined with increased precipitation on the watershed, initiated a cycle of erosion which washed away the fields near Antelope House (and perhaps part of the site itself) and caused the inhabitants to abandon the village for more substantial agricultural areas upstream.

The species composition of materials used in artifacts does not, on the whole, correlate well with climatic fluctuations. There are, however, instructive exceptions.

Charcoal from hearths shows strong similarities with firewood chosen by modern Indian occupants of the Southwest and indicates little change in population density at Antelope House through the period of Anasazi occupation.

Chapter 11

Cultivated and Gathered Plant Foods

One hundred forty-eight plants were identified from the macrovegetal remains excavated at Antelope House, constituting what we believe to be about a 60 to 85 percent identification of all vegetal materials from the site. The larger number would apply to the more important items, such as plants used in artifacts, whereas the smaller number would apply to miscellaneous wood and small parts that might have been overlooked by sorters.

Cultivated Plants

Of the 148 taxa, five are known to have been cultivated in Anasazi times: *Cucurbita mixta, C. pepo, Lagenaria siceraria, Phaseolus vulgaris* and *Zea mays*. *Gossypium hirsutum* also was cultivated at Antelope House.

We hoped to answer the following questions by studying the cultivars from Antelope House. Could the plant materials themselves provide any indication of the conditions under which they were grown? Could we tell whether the crops were dry farmed or irrigated? Did the crops experience drought during growth? Were there fluctuations in the types of crops grown which correspond with changes in weather? Were different types of domesticates (especially corn) grown by the different social groups hypothesized at the site?

In pre-Columbian North America, corn, beans and squash were the basic cultivated plants. In basing his diet on this triumvirate, prehistoric New World man made a wise, if unconscious, choice. Although corn is an inadequate source of the amino acid lysine, beans are not and the combination of these plants provides a protein of high biological value. The flesh of cucurbits is high in vitamins and carbohydrates, while the seeds are a good source of fats and protein. Cotton, the last of the cultivars from Antelope House, has seeds which yield large amounts of protein, fats and carbohydrates, besides providing a fiber for textile manufacture. It is evident, then, that an adequate supply of these four plants can form the basis for a more than adequate diet.

Corn

Many studies have dealt with the introduction and evolution of maize in the Southwest. Galinat and Gunnerson (1963) and Winter (1973) present concise and lucid treatments of this subject. The earliest corn in the Southwest is Chapalote, or small cob, from Bat Cave (3600 BC). Through time, this maize underwent a series of changes, resulting in an increase in ear size and row number and leading to what has been referred to as Basketmaker maize. It appears that at about 500 BC, teosinte germplasm was added to the Bat Cave corn, allowing the extension of maize culture into new and more arid areas.

About AD 700, Harinoso del Ocho, or 8-rowed corn, appeared. This corn was characterized by thick, straight cobs, sometimes swollen at the base, by wide cupules and by wide, crescent-shaped kernels. The blending of teosinte, Chapalote and Harinoso del Ocho produced new and productive types, permitting the cultivation of maize to spead into northern Utah, the Dakotas and across the Rocky Mountains eastward into what is now New England.

These events led to the corn recovered at Antelope House. Where this corn fits into the total picture is discussed below.

Beans

Winter (1973) points out that beans have evolved little through time and that varieties grown prehistorically are still grown today. The four species important to American prehistory are the kidney, or common, bean (*P. vulgaris*), lima beans (*P. lunatus*), tepary beans (*P. acutifolious*) and runner beans (*P. coccineus*). It is *P. vulgaris* with which we are concerned in this discussion. Carter (1945) notes that while the tepary is absent from Pueblo areas, except those adjacent to the Gila-Colorado area, the common bean is found throughout the Pueblo area, but that it is absent from the Gila-Colorado area, except in areas of its post-conquest introduction. The absence of the common bean in certain areas is most probably due to the fact that in areas of extreme heat the tepary will far out-yield the common bean. Both the tepary bean and lima bean have been found associated with Anasazi sites, but only in the Verde Valley in what Kaplan (1956) describes as the Hohokam-Anasazi area. The runner bean has never been reported in association with the Anasazi culture.

Cucurbits

Of the 90 genera and 700 species of Cucurbitaceae, three domesticated *Cucurbita* and the genus *Lagenaria* are important to prehistoric Southwestern archeology (Winter 1973). Although some wild Cucurbita species were utilized, *Cucurbita pepo, C. mixta* and *C. moschata* appear to have been cultivated. Although *C. moschata* has not been recovered from Antelope House, it appears to be a closer relative of *C. mixta* than of *C. pepo* and its absence can be explained by its inability to survive under the climactic conditions in the vicinity of the site.

Cotton

In Arizona, Bohrer (1970) has reported the recovery of cotton seed with a date of AD 100–300 and Kent (1957) reports that in northern Arizona cotton was received as a trade item between AD 700 and 900. Bohrer further states that all evidence of cotton in north central and northern Arizona from AD 700–1100 lacks seeds and other portions of the plant. The evidence seems to indicate, then, that prior to AD 1100 cotton was not cultivated north of southern Arizona. That cotton cultivation apparently was not adopted earlier in the north could be due to genetic peculiarities of the plant, which restricted its growth to the southern parts of the state, or to the fact that such evidence simply has not yet been recovered. That the pueblos were technologically ready for the manipulation of a fiber crop by AD 900 has been shown by Kent (1957); not only were they familiar with agriculture, but they also had a knowledge of spinning, weaving and the use of hair in textiles.

Not only does cotton have value as a fiber source, it also can be used as a food. Castetter and Bell (1942) report that the Pima parch cotton seed and eat it like popcorn, while Beaglehole (1937) reports a similar use by the Hopi.

Method

Corn

The cluster of female flowers—the cob—is the plant portion of corn most frequently recovered and most often studied. This inflorescence is composed of pairs of spikelets which, upon pollination, give rise to the grains we see arranged in rows on the mature ear. The number of these rows on the ear is simple to determine and most useful in analysis (Cutler 1966), although under adverse growing conditions small ears with fewer rows than normal may be produced. Row number is one trait used in analyzing the remains of maize at Antelope House.

Other distinct morphological features of the cob also were used in analysis (Fig. 39). One such feature is the cupule (Nicherson 1953), which is best described as a cup-like depression arising above (i.e., towards the tip of the cob) the point of attachment of a pair of spikelets. The more ancient races of maize tend to have smaller cupules than do later types. Cupule width is determined by holding a pair of calipers at right angles to the surface of the cob, perpen-

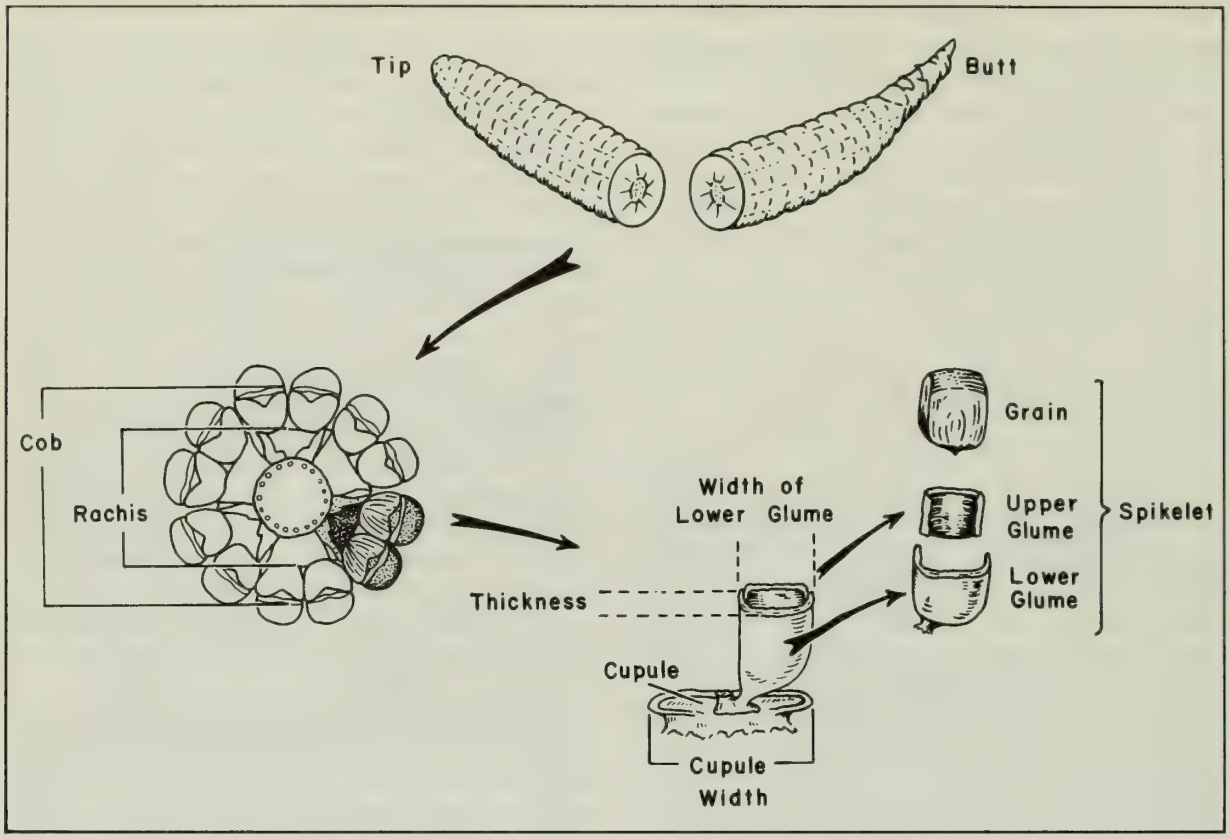


Figure 39. Analytical features of a corn cob.

dicular to the long axis, and measuring the distance, in millimeters, between the outside edges.

Another trait used in analysis is kernel thickness, which can be determined in the absence of the kernel (Nickerson 1953). Surrounding the lower portion of the grain are floral structures called glumes, the lower glume being appressed to the surface of the kernel toward the butt. The distance, along the longitudinal axis of the cob, between the lower glume and the upper edge of the cupule associated with it is equal to the thickness of the kernel which occupied the space. This measurement is also recorded in millimeters.

Nickerson (1953) was able to obtain information of value by measuring the width of the lower glume. The widest part of this structure reflects the width of the basal portion of the grain which it enclosed. The glumes may be broken or absent, yielding a misleading measurement, if any.

The loose kernels, or fruit, also can supply information about type (dent, flint or flour), color and row number of the cob from which they came. When observing a kernel from the "front" (the side on which the embryo is observable), an angle formed between the sides 90° opposed to this side can be seen. The measurement of this angle provides, with a high degree of accuracy, the number of rows of grains on the cob from which it came; a kernel from a 12-row cob will have an angle of approximately 30°, an 8-rowed kernel's angle will be 45° and a 10-rowed kernel's 36°. Fourteen and 16-rowed cobs have kernels with angles of 25.7° and 22.5°, respectively. In the latter two cases, accuracy is somewhat diminished, but grains from the center of the cobs can provide measurements if these are tempered by reservations based on the accuracy of the measuring instrument and the experience of the investigator performing the measurement.

Kernel color, which tends to fade to orange with time, is not always obscured by age. The pericarp and the aleurone generally are used to determine color. The pericarp is the wall of the

ovary after it has matured into a fruit. The aleurone is the outer layer of cells of the endosperm of a seed, the tissue containing the food reserves which nourish the developing seedling upon germination and which also contains the nutrients utilized by man when he eats the grain.

Since no whole plants were found, little can be said about the size of the plants. Parts of corn plants other than cobs, ears or kernels were present, but descriptions of these parts are not included here.

Beans

The beans from Antelope House were identified and classified according to the criteria established by Kaplan (1956). Species were identified by examination of the hilum and on the bases of the general shape and color of the seed. Measurements of seed dimensions were made with a vernier caliper and are given in centimeters. The measurements included length (anterior to posterior extreme), width (ventral to dorsal margin) and thickness (one lateral surface to the other). The shape of the anterior and posterior ends, the three-dimensional shape, the appearance of the eye ring, color pattern, ground color and gloss, when combined with the measurements, were used to make varietal comparisons. Color was determined using a Munsell Color Chart.

Cotton

Four of the characteristics used by Stephens (1967) and Smith and Stephens (1971) to identify archeological cotton remains were employed in identification of cotton recovered from Antelope House:

1. Estimated lock number. Utilizing individual segments, or locks, their number is calculated from 2r-ns, where r is the septum width, s the width of the segment and n the number of locks per boll.

2. S/r ratio. S is the segment width, r the width of the septum to the inside of the boll wall, plus the thickness of the segment. The theoretical ratios are 2.10 for a 3-lock boll, 1.57 for a 4-lock boll and 1.26 for a 5-lock boll.

3. Boll index. This is the maximum diameter of the boll, expressed as a percentage of boll length from base to tip of beak. For archeological material, diameter is estimated as twice the sum of the septum width, plus the segment thickness. The boll index is a reflection of boll shape; higher values mean more rounded bolls, in which seed grade is correlated to seed weight and, therefore, to seed size (Smith and Stephens 1971).

4. Seed grade. This is the geometric mean of the maximum seed diameter and the maximum seed length. Allowance is made for the tuft beyond the tip of the seed when it is present. While seed grade is a good measurement of seed comparison for modern fresh material, its meaning may be somewhat dubious when comparing archeological remains with modern specimens, due to shrinking of the old remains through drying and age. No bolls were expanded in boiling water and chemical delinting was not used in making seed measurements.

In order to compare archeological material with modern specimens, measurements were made of two varieties of modern *Gossypium hirsutum* var *punctatum*. These plants were obtained from John Endrezzi of the Department of Agronomy and Plant Genetics at the University of Arizona, who identified the archeological specimens as *G. hirsutum* var *punctatum*. The two modern cotton varieties were Hopi Sacaton and Hopi Moenkopi. They differ primarily in the dark punctuations of the segment walls in Hopi Sacaton and the very light punctuations of Hopi Moenkopi. The seeds of Sacaton are larger than those of Moenkopi. Moenkopi also shows a higher mean lock number per plant than does Sacaton.

Specimens of Hopi Sacaton were planted at Canyon de Chelly National Monument during the summer of 1973 to see whether cotton would produce bolls there and to provide further comparisons with the archeological remains if the plants survived to maturity. Plants at Monument Headquarters produced bolls and plants at Antelope House would have succeeded had they not been flattened by a tour truck.

No attempt was made to analyze the matted, fragile and often charred cotton fiber, other than to identify it as such. Improved techniques and more specific goals may make this time consuming job worthwhile at some future date.

Cucurbits

Identification of the remains of Cucurbitaceae is based on morphological characters established by Whitaker and Davis (1962) and Cutler and Whitaker (1961). In order to assess these

characters, rinds, seeds and peduncles must be present.

The only species which can be reasonably identified by rind fragments are *Cucurbita mixta* and *Lagenaria siceraria*. All species of *Cucurbita* have: (1) rind that typically is 1–10 mm thick; (2) a slightly furrowed, but sometimes smooth, surface appearance; (3) an epidermal (surface) layer of cells; (4) several layers of hard, thick-walled cells beneath the epidermis; and (5) an inner layer of cells, described as large, isodiametric, thin-walled and irregularly arranged. *C. mixta* can be identified by the presence of corky ridges on the outer surface.

Lagenaria rind tends to have a smooth surface, usually without an epidermal layer, and ranges from 1 to 16 mm in thickness. Beneath the epidermis is a small layer of short, thick-walled cells, formed by small, loose, thin-walled cells. The inner layer of cells is composed of large, loosely organized cells.

C. foetidissima, a wild species, is characterized by thin, paper-like and frequently twisted rind fragments. Most rind fragments remain unidentified or are designated *Cucurbita* sp., as identification to genus can usually be made.

Seeds of cucurbita lend themselves more readily to identification. Those of the bottle gourd (*Lagenaria siceraria*) measure 10–15 mm in length and are narrow, flat and two-pronged at the apex. Seeds of *C. pepo* are approximately 10–18 mm long and light colored (tan to white), with a raised, smooth, well-differentiated margin of the same color as the body of the seed. In *C. mixta*, the margin and the body are of the same color, either white or tan. The body usually is checked or split in various patterns, while the margin is raised, smooth, well-differentiated, rounded and sometimes barely scalloped.

The peduncle is the plant part by which the fruit is attached to the stem. In *C. pepo* the peduncle is hard, five-angled, usually deeply furrowed and may or may not flare slightly at the base. These peduncles are roughened by coarse setae. In *C. mixta* the peduncle is five-angled, hard and distorted, as the diameter is increased by the addition of a firm, warty cork. It is usually not expanded at the base. In the case of *Lagenaria*,

Figure 40. Corn cobs (top) from BM III Structure 67 (1163); from left, one 8-rowed cob, two 10-rowed and two 12-rowed. Cobs (bottom) from PI Structure 70 (1106); from left, two 8-rowed cobs, two 10-rowed, two 12-rowed, one 14-rowed and one 16-rowed.

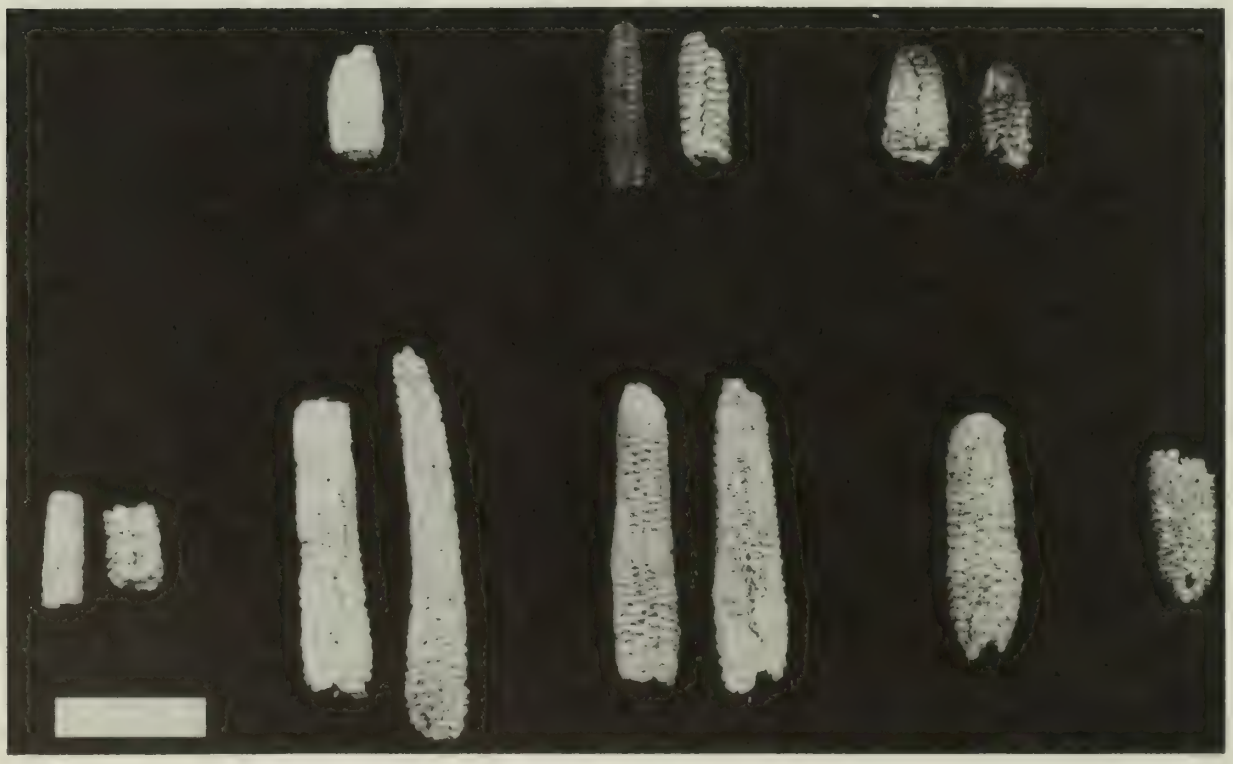


Table 40. Location (room/provenience) and period of cultivars examined.

Location	*Period*[a]	*Cultivar*[b]	*Location*	*Period*[a]	*Cultivar*[b]	*Location*	*Period*[a]	*Cultivar*[b]
67–71/1103	BMIII	M,C,S	31/589	MPIII	M,B,C,S	18/574	LPIII	M,C,S
67–71/1111	BMIII	M,S	1/071	LPIII	M,C,S	18/650	LPIII	M,C,S
67–71/1125	BMIII	M,S	1/075	LPIII	M,C,S	18/651	LPIII	M,C,S
67–71/1110	PI	M	1/079	LPIII	M,C	18/1033	LPIII	M
KVA/202	PI	M,B,S	1/083	LPIII	M,C,S	18/1039	LPIII	M,S
70/1106	PI	M,C,S	1/084	LPIII	M,B,C,S	18/1041	LPIII	M,B,C,S
1/1234	PII	M,S	1/317	LPIII	M,B,C,S	23/1401	LPIII	M,B,C,S
1/1235	PII	M,S	1/337	LPIII	M,B,C,S	23/1402	LPIII	M,B,C,S
1/1236	PII	M,S	1/339	LPIII	M	23/1403	LPIII	M,S
1/1309	PII	M,S	1/340	LPIII	M,B,C,S	23/1404	LPIII	M,C,S
18/1144	PII	M,S	2/753	LPIII	M,C,S	23/1405	LPIII	M,B,C,S
18/1146	PII	M	2/759	LPIII	M,B,C,S	23/1406	LPIII	M,S
29/1326	PII	M,B,S	2/762	LPIII	M,B,C,S	25/745	LPIII	M,B,C,S
68/164	PII	M,B,S	2/769	LPIII	M,C,S	26/1118	LPIII	M,C,S
68/165	PII	M,S	2/770	LPIII	M,C,S	27/245	LPIII	M,B,C,S
68/166	PII	M,S	2/771	LPIII	M,C,S	29/1158	LPIII	M,C
75/1203	PII	M,C,S	5/893	LPIII	M,B,C,S	29/1161	LPIII	M,C
76/1224	PII	M,S	5/896	LPIII	M,B,C,S	29/1173	LPIII	M,B,C,S
KvD/155	PII	M,B,S	5/900	LPIII	M,B,C,S	29/1262	LPIII	M,B,C,S
KvD/167	PII	M,C,S	5/1120	LPIII	M,S	29/1265	LPIII	M,B,C,S
KvD/170	PII	M,B,S	5/1121	LPIII	M,B,C,S	29/1268	LPIII	M,B,C,S
1/1233	EPIII	M,S	5/1124	LPIII	M,B,S	42/242	LPIII	M
1/1237	EPIII	M,B,S	5/1126	LPIII	M,B,C,S	42/247	LPIII	M,C,S
29/1294	EPIII	M,S	16/496	LPIII	M	42/255	LPIII	M,C,S
29/1318	EPIII	M,B,C,S	18/562	LPIII	M,B,C,S	57/768	LPIII	M,S
77/1225–28	EPIII	M,B,C,S						

a = BMIII: Pre-AD 700; PI: AD 700–900; PII: AD 900–1100; EPIII: AD 1100–1140; MPIII: AD 1140–1200; LPIII: AD 1200+

b = M: *Zea mays* (corn); B: *Phaseolus vulgaris* (beans); C: *Gossypium hirsutum* (cotton); S: *Cucurbita* sp. and/or *Lagenaria siceraria* (squash and gourds)

the peduncle is not a good diagnostic character.

All the traits just described vary to some extent, and experience, plus a collection of identified plant parts, is most helpful in making a final judgment. In some cases, only an educated guess is possible, which usually results in a classification only to genus.

Results and Discussion

Of the 2 metric tons of vegetal materials recovered, we estimate that approximately 35 percent are beans, corn, cotton and cucurbits, with corn accounting for close to 80 percent of this figure. Table 40 gives the locations at Antelope House from which the cultivated plants were recovered.

Corn

The remains of *Zea mays* L. recovered at Antelope House consist of cobs, ears with kernels, kernels alone, husks, leaves, shanks, stem portions and tassels. The greatest amount of information was obtained from the cobs, ears and kernels. In a preliminary report of maize remains from Room 21 at Antelope House, Cutler (1973) estimated the height of the corn plants grown there at 1 m to 1.4 m, based on fragments of corn stems. Some of his data are incorporated in this discussion, but primary emphasis is on those corn remains which constitute all or portions of the female inflorescence.

Cobs, BMIII. The Basketmaker cobs are fragmented, as can be seen in Figure 40. The absence of 14 and 16-rowed cobs (Table 41) is unfortunate, but common. The absence of these cobs is reflected in a lower mean row number (10.12) than might be expected, as Basketmaker cobs from other sites have higher row numbers (Anderson and Blanchard 1942; Cutler and Meyer 1965; Hurst and Anderson 1969). These cobs, although not whole, show characteristics described as tripsacoid Chapalote by Galinat and Gunnerson (1969).

Table 41. Measurements of corn cobs (*Zea mays* L.).

Period & Location[a]	Total Cobs	Mean Measurements (mm) Cupule Width	Lower Glume Width	Grain Thickness	Mean Row No.	% Row Number 8	10	12	14	16
BMIII										
67–71	17	7.03	5.13	3.84	10.12	23.5	47.1	29.4	0.0	0.0
PI										
67–71	1	6.90	6.20	4.20	10.00	—	100.0	—	—	—
70	28	7.40	5.30	3.50	10.93	10.7	42.8	39.3	3.6	3.6
KvA	18	7.00	5.20	3.60	10.56	27.8	27.8	33.3	11.1	0.0
Mean	47	7.24	5.28	3.55	10.76	17.0	38.3	36.2	6.4	2.1
PII										
1	57	6.60	4.80	3.62	10.49	22.8	36.8	33.3	7.1	0.0
18	22	5.50	3.29	3.52	10.27	36.4	22.7	31.8	9.1	0.0
21[b]	818	—	—	—	10.37	23.6	39.1	33.6	2.3	1.4
29	83	7.78	5.35	3.85	10.29	30.1	30.1	34.9	4.9	0.0
68	68	7.02	5.28	3.85	10.65	26.5	23.5	42.6	5.9	1.5
75	27	6.67	4.59	3.70	10.15	37.1	25.9	29.6	7.4	0.0
76	15	7.03	4.96	3.78	9.87	33.3	46.7	13.3	6.7	0.0
KvD	5185	7.28	5.09	3.80	10.87	17.5	33.7	38.7	8.1	2.0
Mean	6275	7.27	5.08	3.80	10.78	18.8	34.2	37.9	7.3	1.8
EPIII										
1	48	7.87	5.81	4.77	10.38	25.0	37.5	31.2	6.3	0.0
21[b]	159	—	—	—	10.04	34.5	38.0	20.5	6.0	1.0
29	210	7.64	5.64	3.94	10.88	3.3	54.3	38.1	3.3	1.0
77	47	6.71	5.14	3.97	9.96	34.0	34.0	32.0	0.0	0.0
Mean	464	7.53	5.59	4.08	10.45	19.4	44.8	30.6	4.3	0.9
MPIII										
21[b]	2887	—	—	—	11.28	12.9	27.9	44.5	11.9	2.8
31	54	7.20	5.71	3.95	10.22	25.9	40.7	29.6	3.8	0.0
Mean	2941	7.20	5.71	3.95	11.26	13.1	28.1	44.2	11.8	2.8
LPIII										
South Room Block										
1	597	8.27	5.45	3.98	11.05	15.2	29.1	44.8	9.7	1.2
2	482	7.64	5.25	3.78	11.17	18.9	27.8	46.7	5.8	0.8
21[b]	941	—	—	—	10.71	21.2	30.0	43.0	4.0	1.8
23	1724	8.06	5.62	3.96	10.98	16.4	30.2	43.2	8.6	1.6
29	418	8.02	5.73	4.16	10.78	20.3	31.1	39.7	7.2	1.7
Mean	4162	8.02	5.54	3.96	10.88	18.0	29.8	43.4	7.3	1.5
Central Room Block										
16	76	8.17	5.93	3.84	10.08	30.3	40.8	23.7	5.3	0.0
25	33	7.99	5.61	4.01	10.24	30.3	36.4	27.3	3.0	3.0
26	16	8.46	5.74	4.36	10.00	37.5	25.0	37.5	0.0	0.0
27	371	7.89	5.85	4.14	11.42	7.6	25.9	56.0	9.2	1.3
42	18	7.93	5.73	4.06	9.89	27.8	50.0	22.2	0.0	0.0
57	53	6.67	4.91	3.57	10.11	34.0	34.0	26.3	3.8	1.9
Mean	567	7.84	5.75	4.04	10.96	15.9	30.0	45.7	7.2	1.2
North Room Block										
5	1149	7.94	5.65	4.04	10.59	21.3	34.7	38.1	5.1	0.8
18	770	8.11	5.78	3.98	10.76	17.3	34.7	41.7	5.4	0.9
28[b]	141	—	—	—	9.87	39.0	34.0	23.0	2.7	1.3
41[b]	200	—	—	—	11.23	12.3	28.0	45.7	13.3	0.7
Mean	2260	8.01	5.70	4.02	10.66	20.3	34.1	39.0	5.8	0.8
LPIII Mean	6989	8.00	5.62	3.99	10.82	18.6	31.2	42.2	6.8	1.2

a = refer to Table 40 for provenience sampled within room.
b = Cutler 1973.

On the basis of a chi-square analysis of row numbers, Basketmaker cobs differ from those of all other phases at Antelope House except MPIII. Comparison of Antelope House BMIII with that from other Basketmaker sites (Mummy Cave, Cottonwood Cave and Step House) shows a similar relationship; only when compared with cobs from Turkey Cave in Segi Canyon, Arizona, is a non-significant difference of types (based on row numbers) shown. I believe these results are due to the small sample from Antelope House.

An apricot pit (*Prunus armeniaca*) found in Provenience 1125 (Structure 67–71) obviously is a modern intrusion. Although some contamination may have occurred, it has not significantly affected the results reported here.

Cobs, Pueblo I. As shown in Figure 40, the Pueblo I cobs are larger and less fragmentary than those classified as Basketmaker III. Some of these 47 specimens retain the tripsacoid character of tapered butts and hard, upcurved glumes, but the other morphological characteristics measured tend to be greater than those of the Basketmaker III type. Whereas no 14 or 16-rowed cobs are present in the Basketmaker III sample, they constitute 8 percent of the Pueblo I cobs, increasing the mean row number to 10.76 (Table 41).

Comparison of PI corn row numbers between rooms, using the chi-square test, yielded non-significant results, but comparisons with Basketmaker corn demonstrated differences. In the Pueblo I, phase larger and potentially more productive corn was present. We have no way of knowing whether any specific cob was flour, flint or dent, but we do know that when this corn is compared with earlier corn from the site, it appears to have had the potential for higher yields.

When the data on row numbers were compared with similar information from other sites, such as Antelope Cave and Mesa Verde (Cutler and Meyer 1965) and Turkey Cave (Cutler 1973), it was found that there was no significant chi-square difference among Antelope House, Antelope Cave and Turkey Cave; all three, however, were significantly different from Mesa Verde.

Cobs, Pueblo II. Ninety-five percent of the Pueblo II corn remains come from Kiva D (Table 41). It can be seen that these data compare quite favorably with those from Pueblo I. These cobs (Fig. 41) still retain some tripsacoid characteristics. The cobs tend to have a slender, tapered rachis, but the shank ends fall into two classes. Some appear to have had large shanks, due to the swollen butts, while the other type has smaller shanks with tapered butts. As discussed below, dent corn, which can have the larger butts, was well established at Antelope House by this time. One benefit of this kind of maize is larger cobs, yielding greater productivity.

In comparing corn row number from PII rooms, it was found for the first time that cobs were approaching a significant difference on the basis of the chi-square test when some rooms were compared individually.

When comparisons are made within the Antelope House complex with other periods, the row numbers of PII maize remains are significantly different from PIII periods, but nonsignificant in comparison with PI. Data received from Cutler (1973: Table 2) also were submitted to the chi-square test. The PII maize from Room 21 was significantly different from the totals for PII maize given, but when compared to individual rooms Room 21 corn was only significantly different from that of Kiva D ($x^2 = 59.057$, d.f. = 4). However, there was no significant difference ($x^2 = 38.46$, d.f. = 24) when all rooms were compared together.

The corn from this phase shows not only an increase in size and, to some extent, a change in shape, but also begins to show differences between rooms at the site. This could suggest different populations of seed corn, perhaps the result of differing selection by different social groups and planting in separate fields.

Cobs, Early Pueblo III. The EPIII corn analyzed is shown in Figure 42. As does the maize from PII, it consists of large cobs, still showing tripsacoid characteristics and having both large butts and tapered butts. The measurements taken from the cobs are also larger than their PII counterparts at Antelope House (Table 41). The proportions of cobs by row number are different and the difference in mean row number reflects this. Although no statistical comparison was made of these mean row number values, when the actual numbers of cobs were compared using the chi-square test the cobs from EPIII were significantly different from those in PII ($x^2 = 37.409$, d.f. = 4). When the row numbers of the cobs in Rooms 1, 29 and 77 were compared, it was found that Room 29 differed significantly from both Room 1 ($x^2 = 29.273$, d.f. = 4) and from Room 77 (x^2

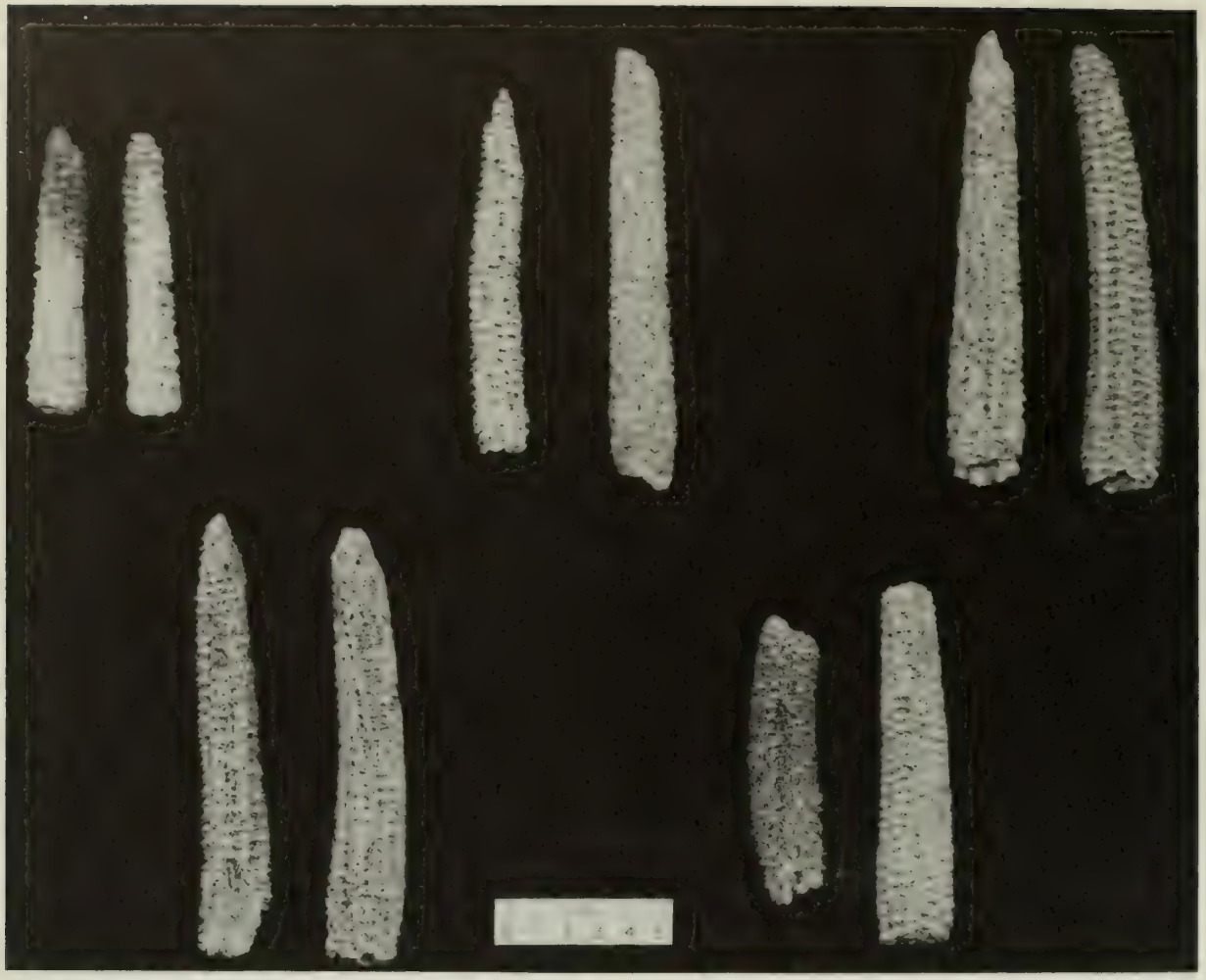


Figure 41. Corn cobs from PII Kiva D (167); top (from left), two 8-rowed cobs, two 10-rowed and two 12-rowed; bottom (from left), two 14-rowed and two 16-rowed cobs.

= 46.190, d.f. = 4). This difference may be due to different corn being grown by the inhabitants of the rooms or it may be due to sample size. When data compiled by Cutler (1973) from Room 21 are analyzed, using this statistic, Rooms 29 and 21 also show significant differences (x^2 = 69.471, d.f. = 4), but the comparison of Rooms 21, 77 and 1 are not significantly different. The result obtained with Rooms 29, 77 and 1 may then be due, not to sample size, but to actual differences, which are revealed on the basis of row number.

When these row numbers for EPIII as a whole are compared, using data compiled by Cutler (1973), with such sites as Benchmark Cave, Echo Cave, Long House and Talus Ruin, these row numbers are significantly different.

Corn from this period differs in many respects from that of earlier periods at the site. Whether the differences found when comparing row numbers are due to inadequacy of the statistic used is not known, but analysis of these findings seem to form a pattern; the later periods at Antelope House are more complex.

Cobs, Middle Pueblo III. The sample of corn examined from this period by me includes only 54 cobs, all from Room 31 (Table 41). The measurements taken from these cobs are similar to those from previous phases examined. The absence of 16-rowed cobs is reflected in the low mean row numbers. Although these cobs were broken up, Figure 42 shows that they retain the morphological characteristics seen in earlier cobs. Hard, upcurved glumes and both expanded and

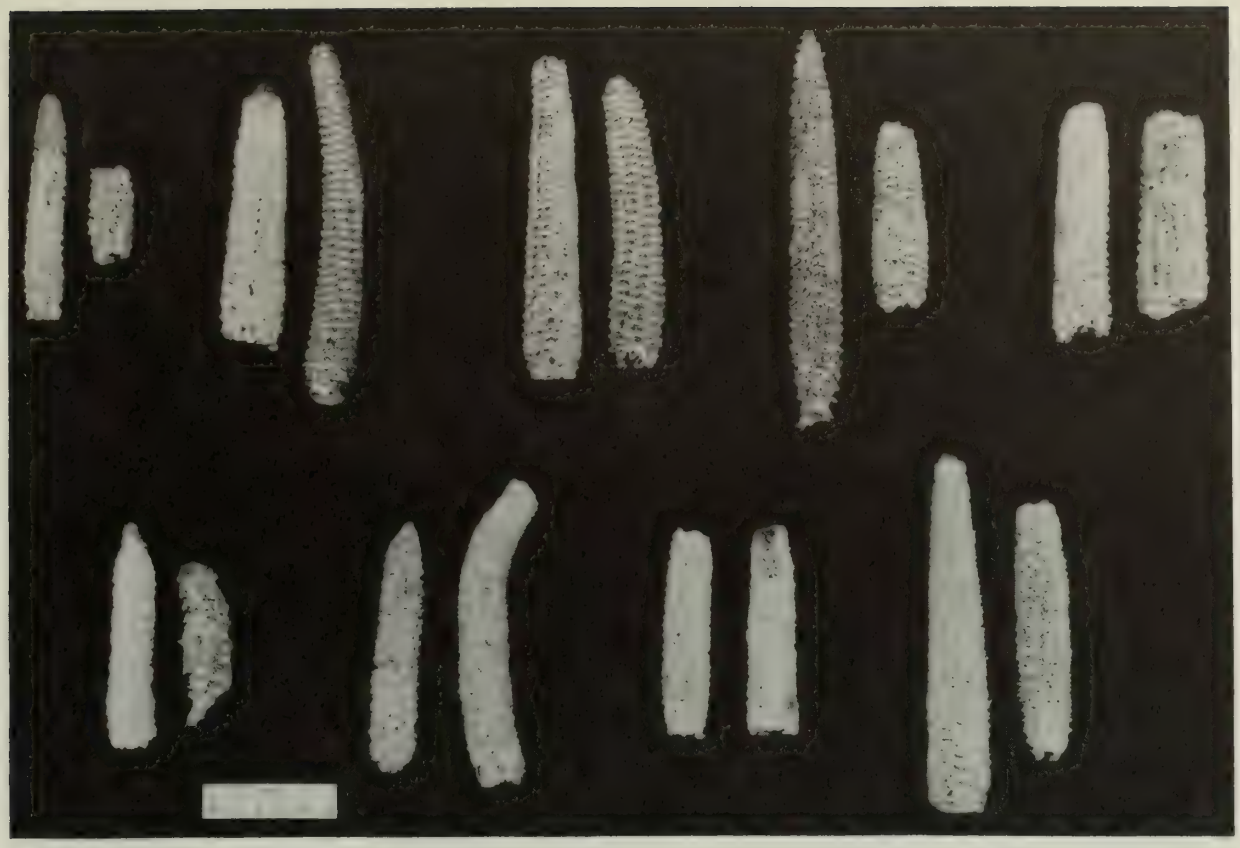


Figure 42. Corn cobs (top) from Early PIII Room 29 (1294); from left, two 8-rowed cobs, two 10-rowed and two 12-rowed. Cobs (bottom) from Middle PIII Room 31 (598); from left, two 8-rowed cobs, two 10-rowed, two 12-rowed and two 14-rowed.

tapered butts are evident. The smaller 8-rowed cob has the appearance of a nubbin, but also appears to have been well filled. The percentages of different row number are similar to those seen in the Basketmaker material; statistically, on the basis of chi-square, they are not significantly different. The same holds true for all other aspects of maize studied.

Comparisons of MPIII row numbers with data from Echo Cave, Long House, Benchmark Cave and Talus Ruin (Cutler 1973) showed no significant differences. The Antelope House cobs may not be a truly representative sample. A larger, more representative sample might yield some differences between these sites and Antelope House.

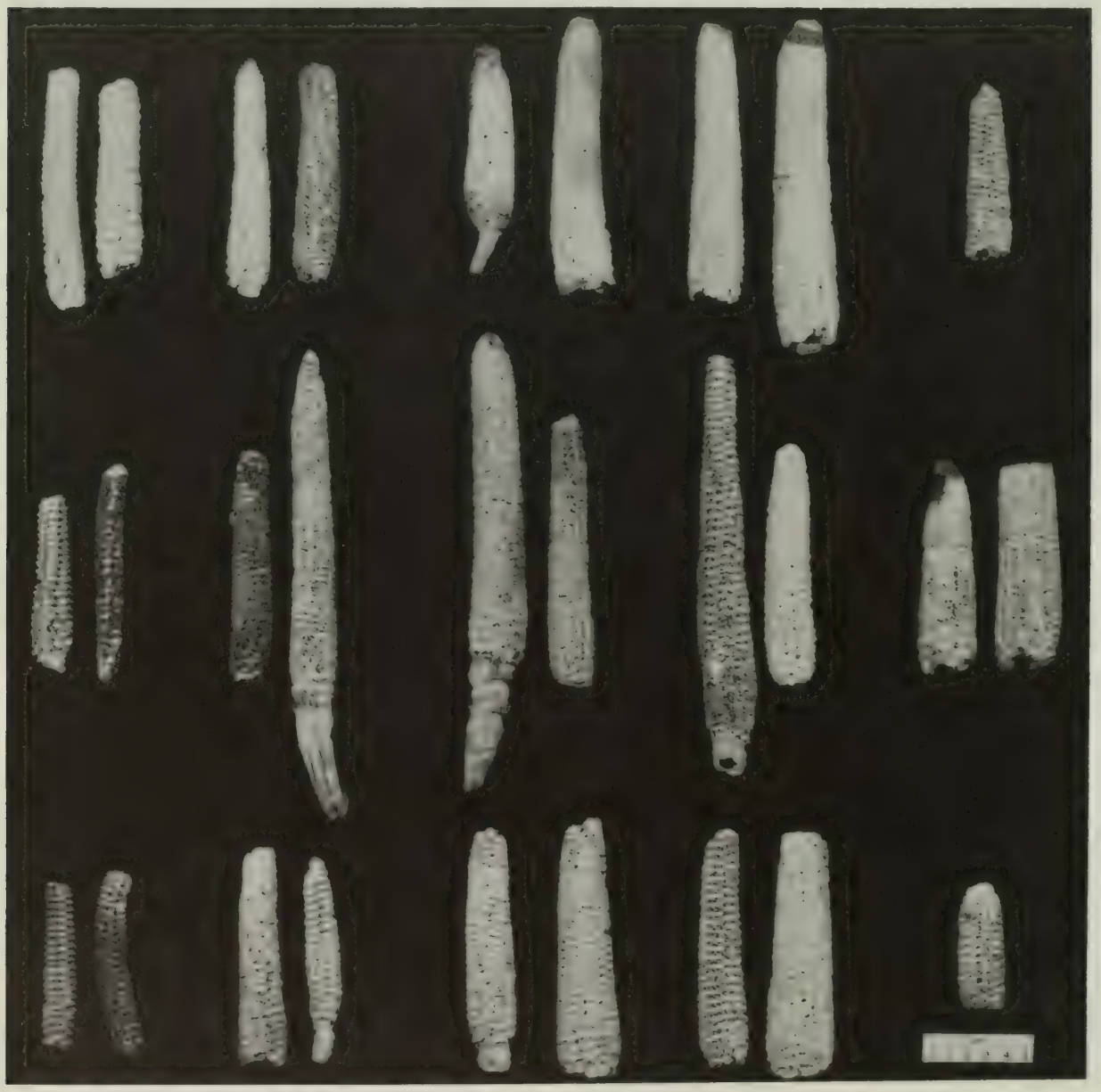
The cobs from Room 21 studied by Cutler (Table 41) were compared with other phases. It was found that these cobs are not significantly different from the Antelope House Basketmaker III and Pueblo I cobs, but that they show a significant difference from PII, EPIII and LPIII cobs. On the basis of the chi-square test, the MPIII cobs from Rooms 21 and 31 are significantly different from one another. The Room 21 material from EPIII and LPIII also differs from the MPIII cobs from Room 21 on this basis.

Data on climatic conditions for this period indicate that it was a time of drought around Antelope House. It is interesting to speculate that the corn recovered illustrates this dry period in the row number comparisons made using the chi-square test. Not only do the row numbers reflect a difference, but MPIII cobs from Room 31 also are smaller than those for previous and subsequent phases at Antelope House. Similar data from Room 21 would help to confirm or deny this idea, since row number measurements from this room do not correspond to those from Room 31.

Cobs, Late Pueblo III. The corn from this phase has been divided into three sub-groups: that from the South Room Block (Rooms 1, 2, 21, 23 and 29), that from the North Room Block (Rooms 5, 18, 28 and 41) and that from the Central Room Block (Rooms 16, 25, 26, 27, 42 and 57).

Examples of what can be called typical cobs from Late Pueblo III are illustrated in Figure 43. Cobs still evidence both swollen and tapered butts. Some cobs from the Central and North Room Blocks still show evidence of hard, up-curved glumes, as was seen in the material from earlier phases. The 8-rowed cobs from the South Room Block appear to be larger and to have softer glumes than do those from the other room blocks. In the Central Room Block, 8 and 10-rowed cobs, with darker glumes and chaff, are also present. The general appearance of the corn

Figure 43. Corn cobs (top) from Late PIII Room 29 (1161), South Room Block; from left, two 8-rowed cobs, two 10-rowed, two 12-rowed, two 14-rowed and one 16-rowed. Cobs (center) from Later PIII Room 27 (24S), Central Room Block; from left, two 8-rowed cobs, two 10-rowed, two 12-rowed, two 14-rowed and two 16-rowed. Cobs (bottom) from Late PIII Room 18 (574), North Room Block; from left, two 8-rowed cobs, two 10-rowed, two 12-rowed, two 14-rowed and one 16-rowed.



from this phase is of large well-filled, highly productive cobs. Other than the difference noted for the 8-rowed remains, the rest of the cobs from the Central and North Room Blocks give the appearance of being larger than those from the South Room Block.

The measurements taken from LPIII cobs generally are larger than those from previous phases (Table 41). The largest difference is that between mean row numbers for MPIII and LPIII. Unfortunately, the MPIII remains, which contributed most to this difference, are ones for which no cob measurements are available. It would be interesting to see whether the measurements of cobs recovered from Room 21 would reflect a difference similar to the value for row number.

Besides comparing the cobs on the basis of cupule measurements, lower glume width and grain thickness, comparisons also were made within and between room blocks using the chi-square test as a measurement of similarities and differences in row numbers of cobs.

Comparison of row numbers between all rooms of the South Room Block as a group shows a significant difference. Room 21 showed a significant difference with Rooms 1 and 23. When Room 21 was eliminated from the chi-square test for the South Room Block the differences in the other rooms were shown to be nonsignificant. A similar situation exists if Rooms 1 and 23 are removed when determining a chi-square. The corn in this room block then may be said to be essentially the same in all rooms on the basis of row number.

Room 27 in the Central Room Block is significantly different from all other rooms in this block on the basis of chi-square tests. When a chi-square was determined for the rooms as a group, a significant difference was found. Elimination of Room 27 from this array produced a nonsignificant difference in the rooms of this room block; that is, all rooms, except Room 27, showed no significant differences on the basis of row number. Whereas in the South Room Block a link could be found between rooms on the basis of row number, Room 27 appeared to be loosely related to any other room in the Central Room Block when compared on the basis of row numbers. When the other criteria (mean cob measurements) are compared, there seems to be a good correspondence with the other rooms. Cutler and Meyer (1965: 140) found that when cobs are piled up and removed, possibly for use, the small cobs tend to be the ones left behind and, therefore, preserved. If this is true for the Central Room Block, then Room 27 may represent the only truly random sample of cobs. The evidence indicates that the Room 27 cobs differ in row number from the others in that room block; these cobs also proved to be significantly different from those removed from all other rooms tested for LPIII cobs.

Only four rooms were analyzed in the North Room Block. A chi-square test comparing row numbers showed these rooms to be significantly different as a group; only Rooms 5 and 18 showed a non-significant difference when compared. This room block shows the least similarity between rooms of the three room blocks surveyed.

The chi-square test also was employed for determining significance between room blocks. This was done both with an array encompassing all rooms and comparing rooms individually.

A room block-by-room block analysis of all possible combinations showed significant differences in number of cobs by row number. Some rooms, when compared individually, are significantly different from all rooms in other room blocks. For instance, Room 27 is significantly different from all rooms in the South Room Block and in the North Room Block. When this room is eliminated in computing a chi-square test for significance between the South and Central Room Blocks, we find $x^2 = 73.456$ with 32° of freedom. When the same comparison is made between the Central and North Room Blocks, $x^2 = 64.600$ with 28° of freedom. Although in both cases the row numbers were shown to be significantly different, a comparison of the number of cobs by row number in individual rooms showed that between the South and North Room Blocks 25 percent of the possible 20 combinations were nonsignificant, while 54.2 percent of the possible 24 combinations between the Central and North Room Blocks showed non-significance. From this result we can conclude that more similarity exists between the Central and North Room Blocks than between the South and North.

The remains from LPIII also were compared with those from contemporary sites. Information on row numbers from Benchmark Cave and Talus Ruin (Glen Canyon) and from Navajo

Mountain and the Chaco Talus Unit was taken from Cutler and Meyer (1965). Further data (Cutler 1973) on Las Madres and Pueblo Largo in New Mexico and from Echo Cave in Glen Canyon also were used. Only the relationship between the Navajo Mountain material and that from Antelope House was nonsignificant. The Benchmark Cave and Talus Ruin material, although significantly different (x^2 = 9.972 and 9.920 respectively, d.f. = 4), might be described as borderline, since with a probability level of 0.025 and four degrees of freedom they are nonsignificant. All other data were significantly different under this test at even the 0.025 level of probability. It appears from this comparison that the LPIII Antelope House material is most closely associated with sites to the west, on the basis of row numbers.

Ears, Pueblo I. Forty-two complete or nearly complete ears were recovered at Antelope House. The earliest was dated PI; the latest (described as "sacred ears") were dated LPIII. Eight complete ears of EPIII corn and 32 of PII corn were studied, along with one ear of questionable date (possibly EPIII).

The sole PI ear recovered is illustrated in Figure 44. It is flour corn, having a row number of 12 (Table 42). Although not a complete ear and showing signs of being very worn, it retained pericarp colors of red and purple and is obviously a portion of a fairly large ear, with the butt and tip ends missing. Measurements (Table 42) show this ear to be much larger than PI cobs (Table 41). It is possible that this is an ear of seed corn that was lost or misplaced, as its size would indicate that it was not simply thrown away; the

Figure 44. Corn ears (top) from PI Structure 58 (1074)—12-rowed flour corn; (center) from mixed dated Grid D (544/183)—12-rowed flour corn, and (bottom) from Early PIII Room 29 (1318)—from left, one 12-rowed flour ear, one 10-rowed flint ear and one 10-rowed, two 12-rowed and one 14-rowed dent ears.

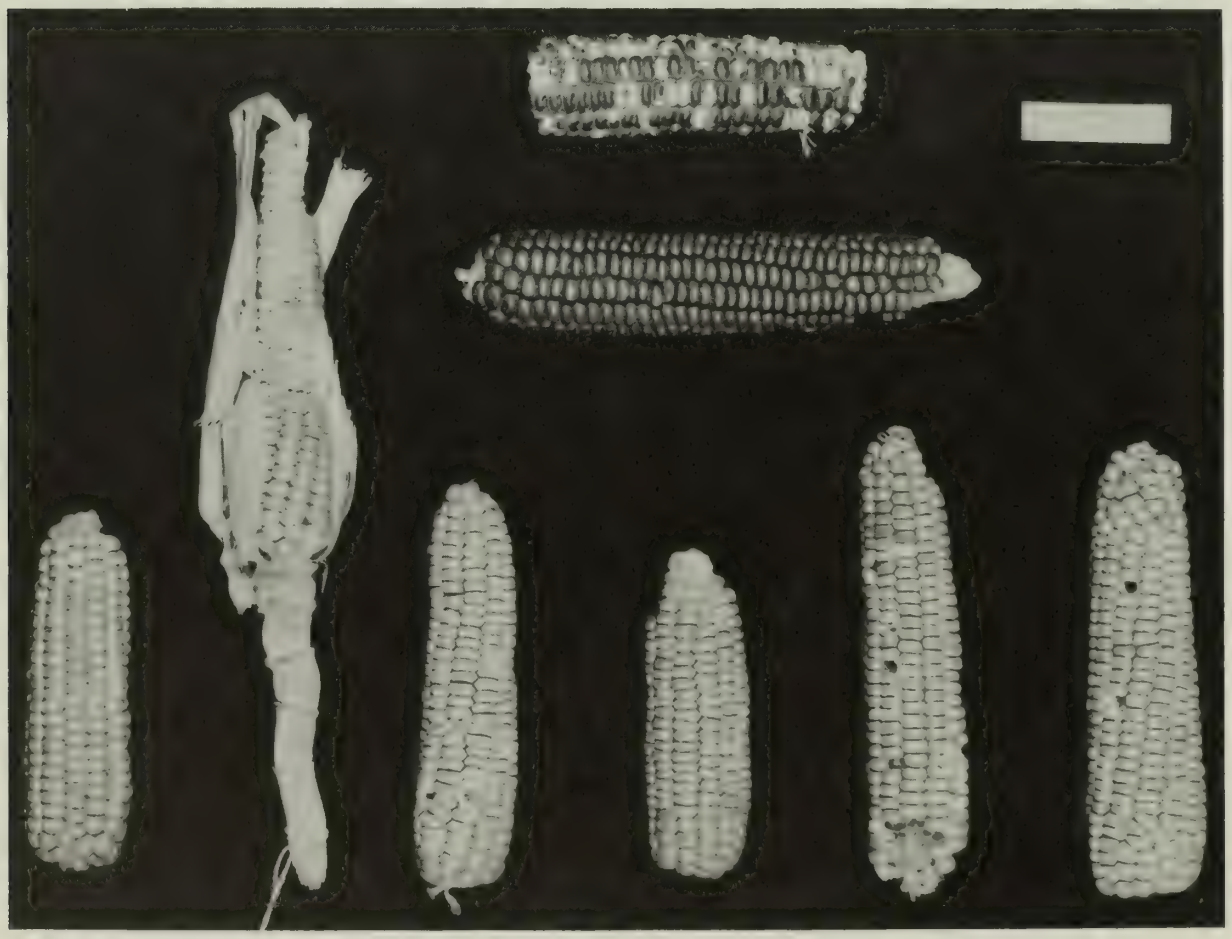


Table 42. Measurements of ears of maize.

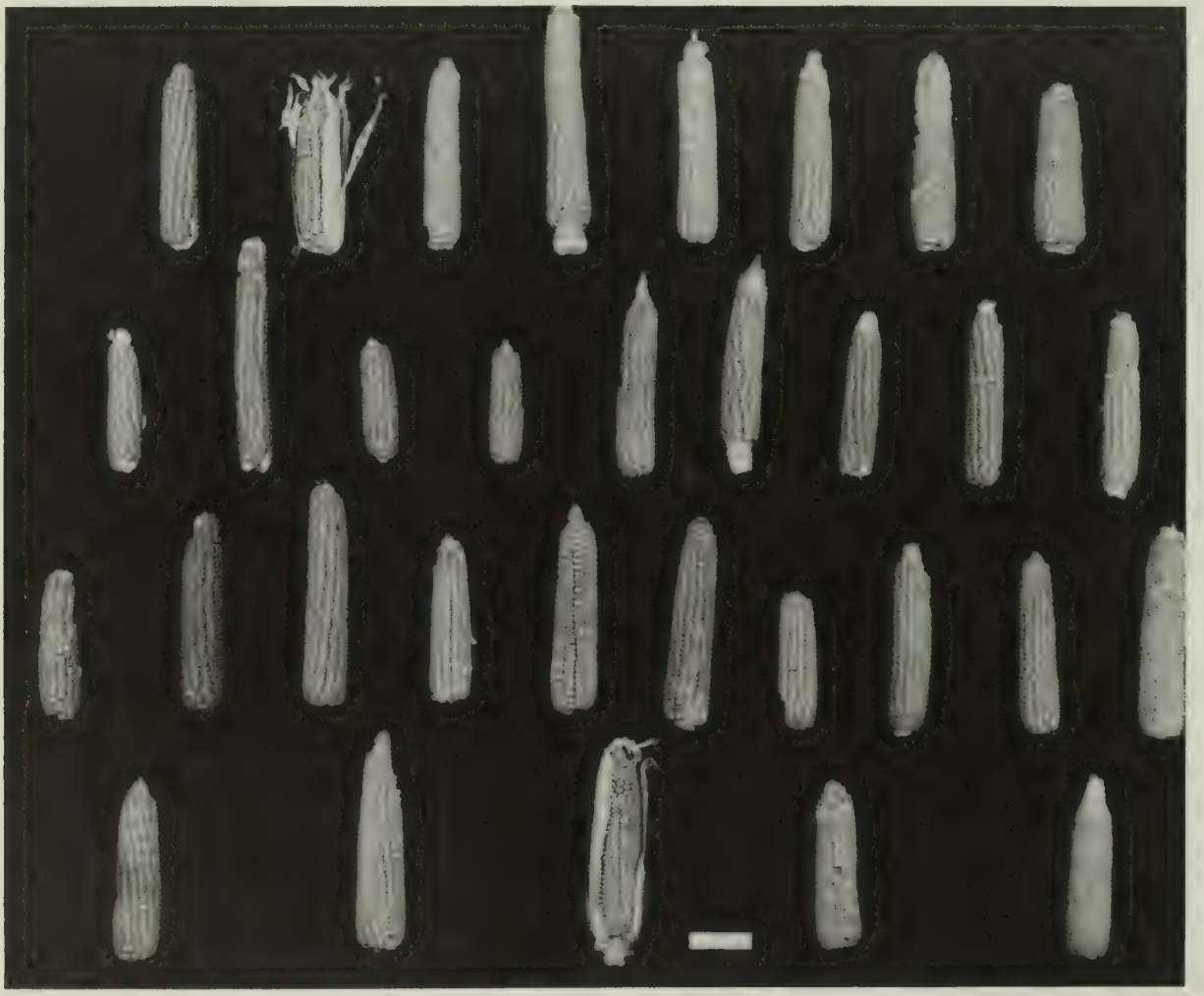
						Mean Measurements (mm)				
			Color[c]			Cob		Kernel		
Period	*I.D. No.*[a]	*Type*[b]	*Per.*	*Ale.*	*Row No.*	*Cupule*	*Lower Glume*	*Length*	*Width*	*Thickness*
PI	121674–1	FLR	R,P	C	12	7.6	6.2	8.2	8.5	6.4
PII	102574–4	FLR	Y,R	Y?	10	6.6	6.8	10.6	9.8	5.1
	102574–1	FLR	C	Y	12	9.2	7.1	10.9	10.0	4.6
	102574–2	FLR	C	Y	12	6.2	7.1	9.9	8.2	4.5
	102974–3	FLR	C,R?	Y	12	7.5	7.2	10.2	9.7	5.0
	102974–4	FLR	Y,R	Y?	12	6.9	7.0	10.5	9.1	4.8
	102974–16	FLR	C	W	12	6.5	6.7	11.2	9.4	4.9
	102574–7	FLR	Y	W	14	6.4	6.9	11.7	9.5	4.5
	102974–15	FLR	C	Y	16	10.6	6.8	11.7	8.5	4.7
	Mean				12.5	7.5	6.9	10.8	9.3	4.8
	102574–8	FLT	C	Y	10	6.8	7.1	9.5	9.3	4.6
	102974–2	FLT	C	R,B	10/8	7.8	7.1	8.6	9.3	5.2
	102974–11	FLT	C	B?	12	6.0	6.5	9.0	9.3	5.1
	102574–13	FLT	C	D	10/12	8.7	7.0	9.7	9.5	5.3
	Mean				10.8	7.3	6.9	9.2	9.4	5.1
	102574–5	DNT	C,D	Y	10	8.6	7.7	9.4	9.6	5.0
	102574–10	DNT	Y	D	10	8.9	7.9	10.6	10.4	4.9
	102574–11	DNT	Y	D	10	8.5	8.2	8.1	9.0	4.8
	102574–14	DNT	R	D	10	8.8	8.2	8.8	10.0	5.2
	102574–15	DNT	R	D	10	8.7	8.1	9.6	9.6	5.0
	102574–12	DNT	D	D	12	6.8	6.5	10.7	9.0	5.1
	102974–1	DNT	R,Y,S,L	D	12	7.9	7.1	11.3	10.2	4.9
	102974–5	DNT	C	B,Y	12	7.7	7.2	10.9	10.2	5.1
	102974–6	DNT	C	Y,R?	12	6.2	6.1	11.2	8.9	4.7
	102974–7	DNT	C	Y,B	12	7.8	7.9	11.1	10.2	5.6
	102974–8	DNT	C	R,Y	12	7.5	7.3	10.6	9.3	5.1
PII	102974–12	DNT	C?	R?	12	7.8	5.4	10.2	8.4	5.0
	102974–13	DNT	C	R,S	12	7.1	7.3	10.2	8.9	4.8
	102974–14	DNT	C	B?	12	7.4	7.2	10.0	8.8	4.7
	102974–17	DNT	R,Y?	B?	12	10.8	7.9	10.8	10.7	5.0
	102574–3	DNT	R?	Y?	14	7.6	6.4	9.7	8.4	5.5
	102974–9	DNT	C	D	14	8.0	6.3	10.4	8.8	5.2
	102974–10	DNT	C	B?	14	7.6	6.1	10.7	8.8	5.1
	102574–6	DNT	C	D,R?	16	7.5	5.0	10.0	8.2	4.2
	102574–9	DNT	C	D	16	5.5	5.7	10.6	8.0	4.1
	Mean				12.2	7.8	6.9	10.2	9.3	4.9
	Mean PII				12.1	7.7	6.9	10.3	9.3	4.9
EPIII	013174–5	FLR	C	Y,S,R	12	6.9	5.4	8.7	10.4	5.3
	013174–1	FLT	Y	Y	10	8.7	5.1	8.8	8.3	5.0
	013174–4	DNT	C	Y	10	6.4	4.8	9.3	10.7	4.3
	013174–2	DNT	C	Y,R	12	6.8	5.3	9.3	10.8	4.3
	013174–3	DNT	Y,R	C	12	6.8	5.1	9.3	10.3	4.3
	013174–6	DNT	Y	Y	14	6.9	4.9	8.7	10.6	5.4
	Mean				12.0	6.7	5.0	9.2	10.6	4.6
	Mean EPIII				11.7	7.1	5.1	9.0	10.2	4.8
LPIII	012374–1	DNT	C	Y	12	5.6	4.5	9.9	8.4	5.0
MIXED[d]	121674–2	FLR	R	C	12	7.2	5.1	10.7	8.7	5.0

a = identification number of cob in Western Archeological Center Plant Collection.
b = FLR; FLT: flint; FLT: slight flint; DNT: dent; DNY: slight dent.
c = B: blue; C: colorless; D: dark orange; L: lighter cap; P: purple; R: red; S: speckled; Y: yellow; ?: could be due to age; Per.: pericarp; Ale.: aleuron.
d = questionable date, could be EPIII.

people growing corn at Antelope House were undoubtedly aware that larger ears, when saved for planting, offered an increase in yield. The coloring and size of this ear is similar to corn grown by both the Hopi and the Navjo today.

Ears, Pueblo II. The data accumulated from the large cache of PII ears recovered from Room 21 is presented in Table 42. There were no 8-rowed ears in this find, although one ear, while listed as a 10-rowed flint, does have eight rows of grain above the middle of the ear (Fig. 45). There is very little difference in the mean sizes of these measurements between the different types of corn found (i.e., flint, flour and dent). The colors listed were determined from a few kernels on each cob. Except for that of one 12-rowed dent, all of these colors had become a dark orange with age. The exception is dark red, with a lighter yellow cap on the kernels. An interesting feature of this corn is the denting. Many ears of flour corn have obvious denting in the crown, especially one 12-rowed and the 14-

Figure 45. Cache of corn ears from PII Room 21 (1318). Cache includes (top row, from left) one 10-rowed, five 12-rowed, one 14-rowed and one 16-rowed flour ears; (row 2) two 10-rowed, one 12-rowed and one 10/12-rowed flint ears, and five 10-rowed dent ears; (row 3) 12-rowed dent ears, and (row 4) three 14-rowed and two 16-rowed dent ears.



and 16-rowed ears, which are deeply dented. The kernels of these ears were found to have soft floury starch throughout, rather than the hard starch, or corneus, layer expected with dent or flint types. These ears reflect characteristics described by Anderson and Cutler (1942) for "Mexican Pyramidal."

As for row numbers in this cache, 25 percent are 10-rowed, 53.1 percent are 12-rowed, 12.5 percent are 14-rowed and 9.4 percent are 16-rowed. Of these ears, 78.1 percent are 10 and 12-rowed, compared to 72 percent for cobs dated PII. That this is a selected group of ears is apparent, not only because of the distribution of the number of rows of grains, but also because of the large kernels, fairly straight rows and completely filled ears with covered tips. This cache is quite variable, with many different colors and textures of kernels and a wide range of row numbers for this period. Straight rows and covered tips are two of the traits often mentioned as criteria used by modern Indians in the selection of seed or ceremonial ears, making it probable that this cache is a selection of several distinct types recognized and chosen by the inhabitants for future planting. It also is probable that the residents of Antelope House recognized that the large-grained dents were valuable; this contrasts with other sites, such as Bernheimer Alcove (Cutler 1966) and Cottonwood Cave (Hurst and Anderson 1949), where collections have shown that more ancient types were selected in preference to the larger, later kinds. The row numbers of the ears from these two sites, like those from Antelope House, are higher than the means for the rest of the site, but they have relatively smaller grains, which is more common in earlier periods.

Ears, Early Pueblo III. The six ears in this cache are shown in Figure 44. As in the PII cache, the mean row number of these ears is greater than for this period as a whole. These ears are smaller than those previously discussed, but they have the large grains and the straight rows expected in ears selected for a special purpose. Most of these ears apparently were yellow originally, but are now faded to a darker orange. In the ear of flour corn there is evidence of red speckling on some of the grains. Two of the dent ears also show red coloration not due to aging. Like the PII ears, these were probably kept aside for seed. Their smaller size could be due to the drought period which began in MPIII, but which could have had an effect earlier. This seems quite probable, since the first and last decades of EPIII were very dry in comparison to the two middle decades.

Ears, Late Pueblo III and Mixed. Although measurements were taken from only one ear dated LPIII, another ear also was recovered; both were described as "sacred ears." The 10-rowed ear of yellow flour corn pictured in Figure 46 was enclosed in a deerskin pouch. Bohrer (1960) mentions a ceremony practiced by the Zunis involving a sacred, or perfect, ear of maize, which is moderate in size and yellow; it is called "father." Dumarest (1918) describes a ceremonial ear of white corn wrapped in cotton thread, from which ". . .not a grain is lacking and at the top of which rises a head of glumes." This characteristic is evident in this ear and is commonly called tassel seed.

The other ear of sacred corn (Fig. 47; Table 42) is a 12-rowed yellow dent, from which not a kernel originally was missing. This ear, too, was wrapped in cotton thread and was adorned with bits of turquoise and brightly colored macaw feathers. A cylinder of hematite also was attached. This ear shows no evidence of tassel seed. Stevenson (1894) describes and pictures a similar ear used for ceremonial purposes by the Zia.

The ear of questionable date, part of a cache intruded into LPIII strata, is a large, red-grained, 12-rowed flour corn (Fig. 44). This ear is in good condition and the color, which is similar to that of corn grown today by both the Hopi and the Navajo, is striking. Because this is a solitary ear, it is hard to say whether it was being saved for a special purpose, but its size and condition lead one to speculate that it was kept aside, most probably for seed.

Kernels, Pueblo I. Information derived from loose kernels is presented in Table 43; 263 kernels were found and analyzed.

Of the eight PI grains recovered, four are flour and four are dent, constituting the only evidence of dent corn early in the history of Antelope House. Although most of these grains have faded to orange, there is evidence of red speckling in the pericarp of one flour grain and some of the dent forms show white capping. Both of these traits can be seen in varieties grown by the Hopi and the Navajo today.



Figure 46. Sacred ear of 10-rowed flour corn in a deerskin pouch from Kiva B Annex (1526).

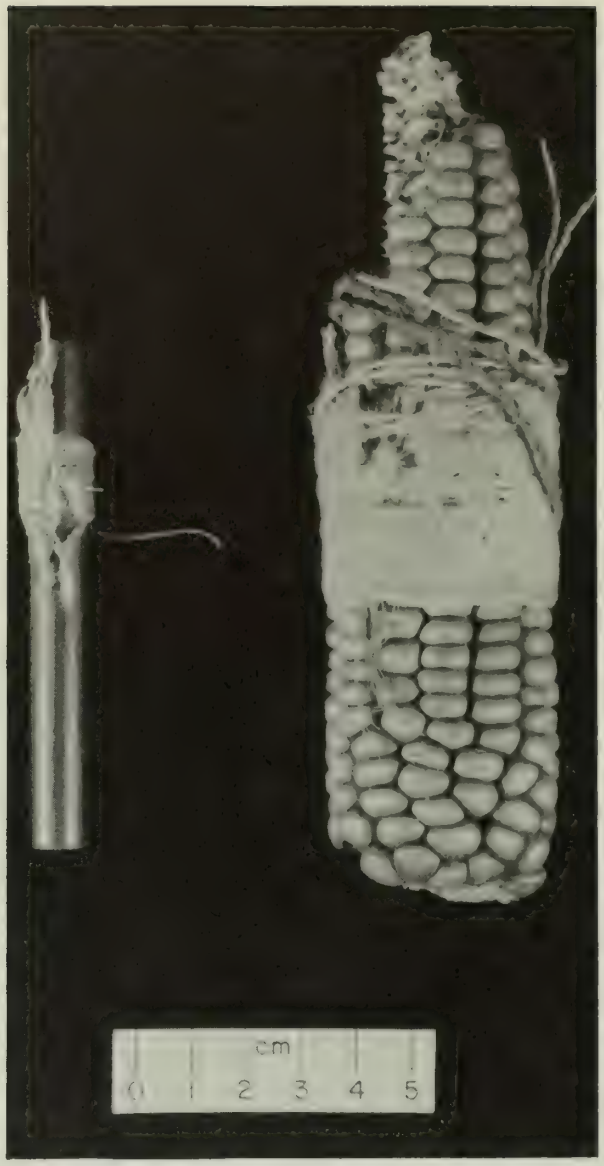


Figure 47. Sacred ear of 12-row dent corn and piece of hematite, originally attached to ear, from Antelope House.

The measurements derived from the flour grains are comparable to those found on the single ear of flour corn discussed above (Table 42). These comparisons also carry over to the dent forms in the cache of PII ears. All grains appeared to come from ears having 10 or more rows of grains.

Kernels, Pueblo II. The 12 PII grains studied are flour corn. Some color, other than orange, is apparent, but the determination of row numbers was impossible in five of these grains.

These grains are fairly large (Table 43) and are again comparable to those found in the large cache of ears studied from Room 21.

Kernels, Early Pueblo III. These 16 grains of flour corn are orange. Some are charred, which could be due to parching of the ears.

Kernels, Late Pueblo III. No loose kernels were found for MPIII; those from LPIII make up more than 86 percent of the total recovered. Most of these grains are of the flour type (79.7 percent), with 12.8 percent flints and 7.5 percent dents.

Table 43. Data on loose kernels of maize.

Period	Location[a]	Type[b]	No. kernels	Row No.	Color[c]	Mean Measurements (mm) Length	Width	Thickness	Notes
PI	Kv A–202	FLR	2	10	O,R,S	8.4	8.6	6.0	Red speckling
		FLR	1	12	O	9.4	9.9	4.3	
		FLR	1	16	O	9.9	7.5	5.7	
		DNT	1	10	O	9.8	9.5	4.9	
		DNT	2	12	Y	10.4	8.5	4.8	White capped
		DNT	1	14	Y	10.7	9.7	4.3	White capped
PII	Kv D–155	FLR	4	8	O	10.0	9.7	5.6	
		FLR	1	10	O	11.0	10.2	4.2	
		FLR	2	12	O,P	9.8	8.4	5.5	
		FLR	4	?	Y,R,P	8.7	9.0	6.3	
	Kv D–167	FLR	1	?	O	8.0	7.4	7.0	
EPIII	29–1294	FLR	4	8	O	8.3	8.6	6.3	
		FLR	6	10	O,Y	9.6	8.9	4.7	Some kernels charred
		FLR	4	12	O	9.2	9.4	5.5	
		FLR	2	?	O	8.0	9.3	5.2	
LPIII	1–071	FLR	2	8	Y	10.4	9.3	4.5	
	1–079	FLR	1	12	Y	—	8.9	5.5	
		FLR	1	14	Y,R	—	8.9	5.5	
	1–084	FLR	1	8	Y	—	9.3	5.0	
		FLR	2	10	Y	—	7.6	5.2	
		DNT	1	12	O	—	10.4	4.1	
	1–317	FLR	68	8	Y,R	9.2	9.2	5.5	Some kernels charred
		DNT	2	8	Y	6.6	6.9	3.6	
		FLR	31	10	Y	9.2	8.2	5.4	Some kernels charred
		FLR	18	12	Y,R,W	9.7	8.5	5.7	
		DNT	3	12	Y,P	—	9.4	4.3	
		FLR	12	14	Y,R,O	9.4	6.8	4.2	
		FLR	3	16	Y,R,O	9.4	7.3	4.6	
	1–337	FLR	3	8	O,P	7.8	9.5	5.4	
		FLT	3	8	O,Y	8.5	9.2	5.1	
		DNT	1	8	O	9.6	10.9	4.9	
		FLR	1	10	O	11.0	9.8	5.6	One side charred
	1–340	FLR	2	10	Y	—	8.0	6.0	
	2–759	FLR	3	8	Y,O	6.3	7.3	5.4	
		FLR	3	10	O	10.4	8.8	5.3	Some kernels charred
		FLR	1	12	O	10.2	9.5	5.1	One side charred
	2–771	FLR	2	8	O	8.8	8.2	4.6	
	5–896	FLT	2	8	O	9.4	9.4	4.8	Fragment of red flint
		FLT	2	10	O	—	10.0	5.6	
	5–1124	FLR	4	8	R,Y,S	9.6	9.4	5.2	Red speckling
		DNT	2	8	R,V	10.8	10.0	4.9	
		FLR	1	10	R,V,S	9.8	8.5	5.0	Red speckling
		DNT	1	10	Y	—	10.6	5.3	
		FLR	4	12	O,R,S	9.6	8.6	5.5	Red speckling
		FLT	1	12	O,R,S	9.5	8.3	5.8	Red speckling
		FLR	4	?	O,Y	8.0	8.7	6.4	Some expanded by heating
		FLT	10	?	O,Y,R	7.8	8.8	5.9	Some expanded by heating
	23–1401	FLR	1	8	B	8.1	9.5	5.7	
		FLT	3	8	B,O,P	8.1	8.8	5.3	
		FLR	2	10	R,B	8.4	8.3	6.4	
		DNT	1	10	Y	9.9	8.8	4.7	
		FLR	3	14	Y,P	8.8	8.3	4.9	
		FLR	6	?	Y,B	7.6	9.0	5.4	
		FLT	3	?	Y,R,P	8.8	9.2	5.3	
	23–1402	FLT	2	8	Y	9.2	8.8	4.9	

continued

Table 43. Data on loose kernels of maize—Continued

Period	Location[a]	Type[b]	No. kernels	Row No.	Color[c]	Mean Measurements (mm) Length	Width	Thickness	Notes
	23–1403	FLT	1	10	O	10.4	9.7	5.9	
		DNT	1	10	Y	10.4	8.8	4.9	
		FLR	2	?	O,Y	9.0	10.1	6.5	
		FLT	1	?	O	7.8	8.6	6.4	
	23–1405	DNT	1	?	Y,O	—	9.3	5.8	White capped
	29–1173	FLT	4	8	Y,O	9.6	10.4	6.4	
		FLT	1	10	O	9.8	9.0	6.0	

a = Room provenience
b = FLR: flour; FLT: flint; DNT: dent.
c = O: orange; R: red; P: pink; BL: blue; Y: yellow; S: speckled; V: violet; W: white.

For almost 12 percent of the recovered grains, no row number could be determined.

Color definition is better for these kernels, as can be seen in Table 43. Although the orange of age is apparent, yellow, pink, blue, red and violet also are apparent. Charring of kernels and other evidence of heating is present, suggesting that the kernels were parched in preparation for eating. The white capping seen in some of the dents from the PI phase also is found in LPIII. In Room 5, a fragment of a kernel of red flint was found. All of these colors can be seen in corn grown by the Hopi and the Navajo today. The sizes of kernels recovered in LPIII give no indication of adverse environmental conditions that could have affected corn yields; that is, the sizes are not abnormally small. If the amounts of particular types are an indication of the quantities grown, then it can be surmised that flour corn was the preferred type.

Beans

In examining the beans from Antelope House, an attempt was made to relate them to varieties or types described by Kaplan (1956). The 157 beans recovered appear to represent seven of the 32 types of common bean described and are taxonomically *Phaseolus vulgaris* L. The types recovered are listed in Table 44 and are illustrated in Figure 48.

Basketmaker III. No bean remains of any kind were found in a BMIII context. The paucity of areas dated BMIII is the most reasonable explanation for this.

Pueblo I. Two bean seeds and a small pod fragment were recovered in a subfloor test trench in Kiva A. One bean most closely resembled type C3, the other C22.

Pueblo II. Although seven PII bean seeds were found in three different locations (Table 44), only types similar to those recovered in PI materials (C3 and C11) were identified. A few of the C3 types appeared to be darker in color. One small pod fragment of *P. vulgaris* also was identified.

Early Pueblo III. In this phase, 37 seeds of *P. vulgaris* were found. A type (C20) different from those previously seen was recovered. The remaining 36 seeds were classified as type C3 and are similar in size and color to the PI and PII varieties described. Pod fragments and strings also were identified as belonging to *P. vulgaris.*

Middle Pueblo III. The only remains recovered for this phase are pods and strings. These are similar to the pods and strings identified for earlier phases.

Late Pueblo III. The bulk (70.7 percent) of bean remains was recovered from this phase. Except for type C20, all types previously found were identified, as were types C1, C14, C19 and C19a. As usual, pods and strings of *P. vulgaris* also were recognized.

Of the 32 types of common beans described by Kaplan, 14 have been found archeologically in association with the Anasazi. Bean distribution in the Southwest was divided by Kaplan into three regions, based on cultural groupings: (1) Mogollon, (2) Hohokam and (3) Anasazi. The

Table 44. Data derived from the remains of *Phaseolus vulgaris* (beans).

Period & Location[a]	No. Beans	Median (Range) Dimensions, cm			Color[b] Comments
		Length	Width	Thickness	
PI					
KvA	1	1.33	.84	.53	Selfed, dark red (1OR 3/2) = C3
	1	1.50	.84	.57	Dark red-brown longitudinal stripe (2.5YR 3/4) on red-brown ground color (2.4YR 4/4) = C11; one small pod fragment of *P. vulgaris*
PII					
29	5	1.35 (1.24–1.42)	.78 (.72–.81)	.59 (.51–.68)	Selfed, red-black to dark red-brown (1OR 2/1 to 1OR 3/2) = C3
68	1	1.32	.81	.62	Dark red-brown stripes (5YR 3/2) on red-brown ground color (5YR 3/4) = C11
KvD	1	1.59	.89	.58	Selfed, red-brown (2.5YR 3/6) = C3; one small pod fragment of *P. vulgaris*
EPIII					
1	1	.80	.67	.55	Selfed, very dark red-brown (10R 2/2) = C20
29	35	1.34 (1.15–1.71)	.75 (.63–.87)	.59 (.49–.68)	Selfed, dark red to dark red-brown to red-brown (5R 3/6; 1OR 3/2–6; 2.5YR 3/4–6) = C3; pod fragments and strings of *P. vulgaris*
77	1	1.46	.79	.59	Selfed, dark red-brown (1OR 3/2) = C3
MPIII					
31	—	—	—	—	Pods and strings of *P. vulgaris*
LPIII					
1	3	1.37 (1.33–1.48)	.77 (.77–.82)	.55 (.50–.58)	Selfed, red-black to red-brown to light red-brown (1OR 2/3–3/4–4/8) = C19
	7	1.39	.81	.57	Selfed or slight fleck, dark red-brown (2.5YR 3/4 and 5YR 3/2) to red-brown (5YR 5/4) = C19a
2	—	—	—	—	Pods and strings of *P. vulgaris*
5	2	1.34 (1.32–1.37)	.76 (.74–.78)	.58 (.54–.61)	Dark red mottle (1OR 3/2) on yellow ground (2.5Y 8/6) = C14
	61	1.28 (1.06–1.65)	.76 (.64–.93)	.56 (.37–.72)	Selfed, dark red to dark red-brown (5R 3/2; 1OR 3/4; 2.5YR 3/4) = C3
	12	1.42 (1.23–1.69)	.78 (.69–.99)	.57 (.45–.67)	Longitudinal striped, dark red to red-brown (1OR 3/2; 7.5YR 3/2) on dark red-brown ground (2.5YR 3/4; 7.5YR 4/4) = C11; seed coat fragment, cotyledon, and pods and strings of *P. vulgaris*
18	6	1.44 (1.21–1.65)	.77 (.65–.92)	.57 (.50–.60)	Selfed, red-black, dark red to dark red-brown (5YR 2/1; 5YR 3/4; 2.5YR 3/6) = C3; fragments of pods and strings of *P. vulgaris*
23	1	1.81	.97	.61	Longitudinal striped, dark red-brown (5YR 3/2) on light red-brown ground (5YR 4/3) = C11
	12	1.43 (1.15–1.59)	.81 (.74–.94)	.59 (.43–.70)	Selfed, dark red to dull orange (1OR 3/2; 2.5YR 3/4; 5YR 5/8) = C1
25	3	1.42 (1.41–1.43)	.83 (.76–.85)	.63 (.61–.64)	Selfed, dark red-brown (5YR 3/2; 5YR 3/4) = C3
27	—	—	—	—	Pods and strings of *P. vulgaris*
LPIII					
29	4	1.36 (1.23–1.50)	.80 (.71–.87)	.59 (.45–.67)	Selfed, red-brown (2.5YR 3/6) to dark red-brown (5R 3/6) = C3; pod fragments and strings of *P. vulargis*

a = refer to Table 40 for proveniences sampled within rooms.
b = color designation from Anonymous, 1968; "C" designation from Kaplan, 1956.

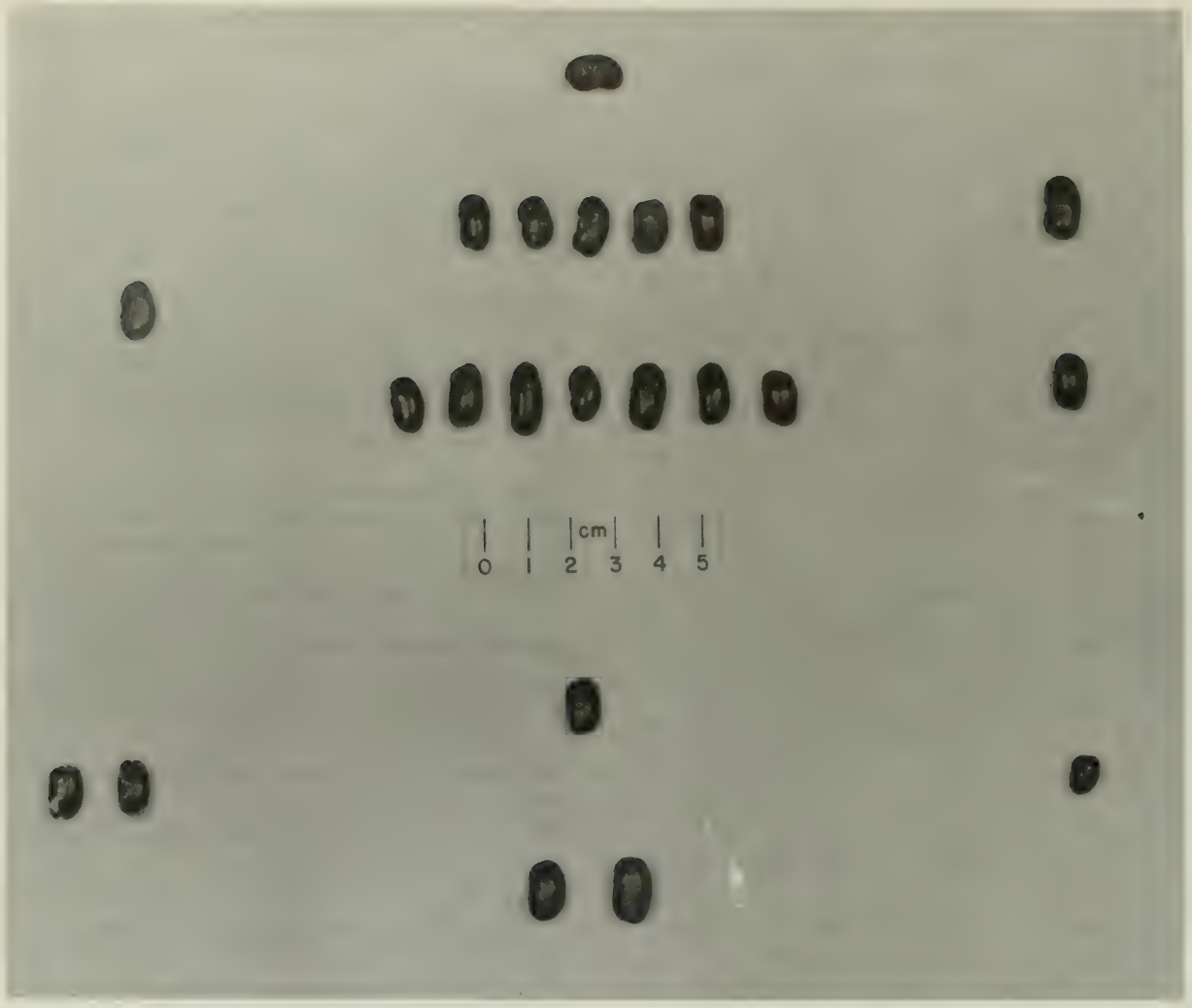


*Figure 48. Beans (***Phaseolus vulgaris***) from Antelope House. Top: (left) Type C1 from Late PIII Room 21 (1401); (center) Type C3 from PI Kiva A (202); (center, row 2) Type C3 from Early PIII Room 29 (1318); (right, upper) Type C11 from PI Kiva A (202); (right, lower) Type C11 from PII Room 62 (164). Bottom: (left) Type C14 from Late PIII Room 5 (1144); (center, above) Type C19 from Late PIII Room 1 (340); (center, below) Type C19a from Late PIII Room 1 (317); (right) Type C20 from Early PIII Room 1 (1237).*

last is composed of Northern Arizona Anasazi, Verde Valley Anasazi, Northern Periphery (southeastern Nevada and southwestern Utah) and Mesa Verde Anasazi.

Of the seven types recognized at Antelope House, all but C3 and C20, previously associated with the Verde Valley Anasazi, have been recovered from Northern Arizona Anasazi sites. Types C1, C11 and C19a also were linked to the Mesa Verde Anasazi. Besides being found with Anasazi remains, types C3 and C11 have also been found in the Northern Periphery and types C1 and C19 in the Mogollon culture area.

Results of our bean analysis indicate a strong association of Antelope House inhabitants with other groups of Anasazi, both those of the Verde Valley and those classified as Northern Arizona Anasazi.

This evidence, then, reiterates previous findings that the agricultural complexes of the Anasazi, the common bean in particular, show the closest relationship to areas to the west and north, rather than to the south and east.

Cucurbits

The remains of cucurbits recovered from

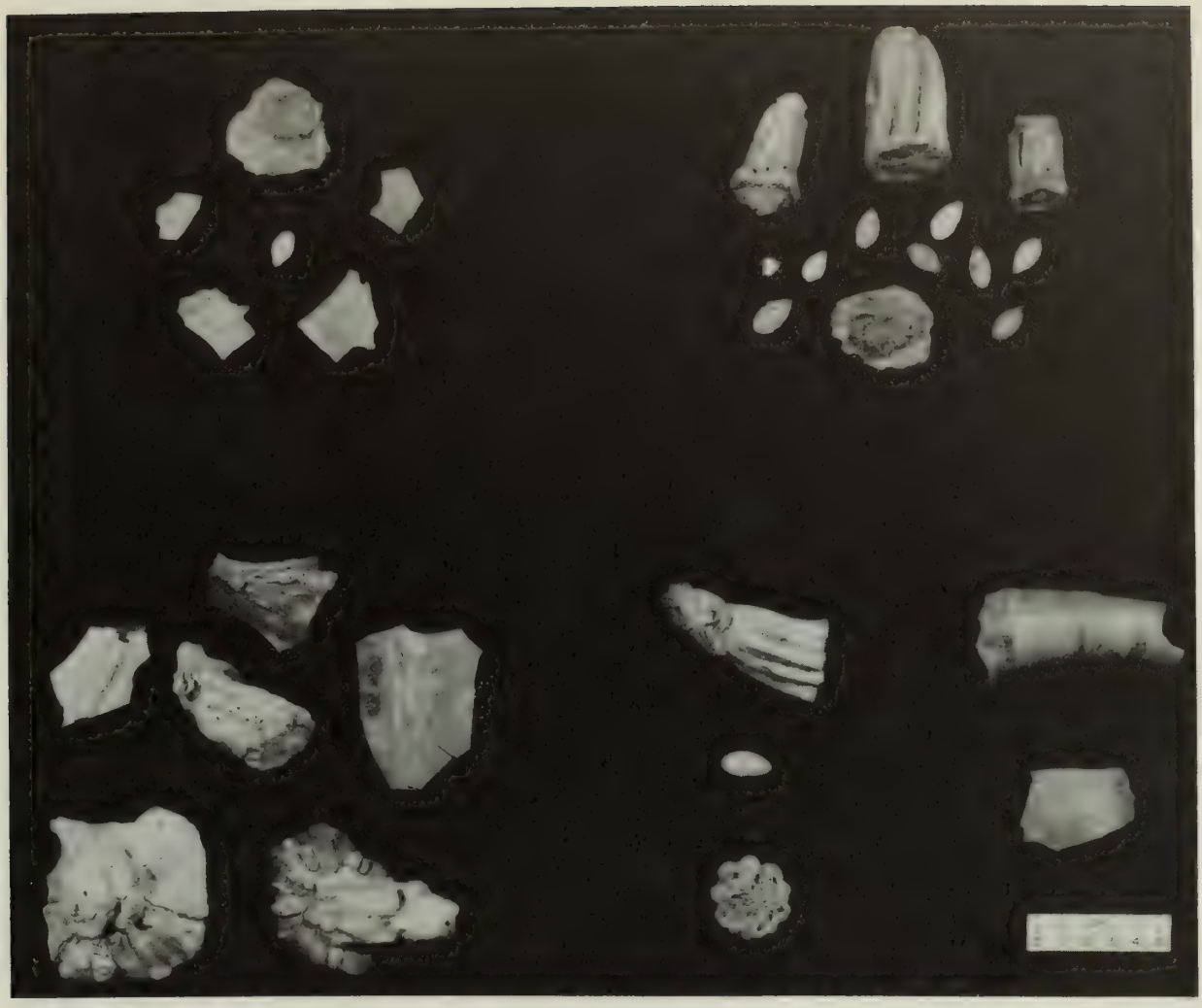


Figure 49. Cucurbitis from Antelope House. Top: (left) peduncle, seed and four rind fragments of **Cucurbita pepo** *from BMIII Room 67 (1103); (right four peduncles and nine seeds of* **C. pepo** *from PI Room 70 (1106). Bottom: (left) three rind fragments and three peduncles of* **C. mixta**, *(center) two peduncles and one seed of* **C. pepo** *and (right) two rind fragments of* **Lagenaria siceraria**, *all from PII Kiva D (155).*

Antelope House are summarized in Table 45. Figure 49 shows some of the seeds and peduncles recovered and identified.

Basketmaker III. One seed of *C. pepo* and 25 rind fragments identified only to genus date to this phase. The rind fragments probably are of *C. pepo.*

Pueblo I. The two PI areas surveyed yielded remains of seeds and peduncles identified as *C. pepo.* The 355 rind fragments found are very eroded and were identified as to species.

Pueblo II. C. pepo is again the dominant species among the identifiable remains. In Rooms 1 and 75, four seeds classed as *Cucurbita* sp. were found. These are too eroded for positive identification, but are probably *C. pepo.* In rooms 76 and Kiva D, five peduncles were recovered. These also are too eroded and fragmented to permit a valid identification, but they are most likely *C. pepo,* as there is no evidence of the corky material to be expected of *C. mixta.* Also in Kiva D were some thin and curled rind fragments, which may represent the remains of *C. foetidissima.*

Rinds and seeds of *C. mixta* and rind fragments of *Lagenaria siceraria* dated PII also were found. It should be noted that this is not the

Table 45. Data derived from remains of cucurbits.

Period & Location[a]	*Cucurbita* sp. R	S	P	*C. pepo* R	S	P	*C. mixta* R	S	P	*Lagenaria siceraria* R	S	P	Comments
BMIII													
67–71	24	–	–	–	1	–	–	–	–	–	–	–	
PI													
70	343	–	13*	–	56	7	–	–	–	–	–	–	fragmented, mostly likely *C. pepo*
KvA	12	–	–	–	2	–	–	–	–	–	–	–	
Total	355	–	13	–	58	7	–	–	–	–	–	–	
PII													
1	46	2*	–	–	–	–	–	–	–	–	–	–	very eroded, most likely *C. pepo*
18	154	–	–	–	70	–	–	–	–	–	–	–	
29	4	–	–	–	2	3	–	–	–	–	–	–	
68	50	–	–	–	2	1	–	–	–	–	–	–	
75	31	2*	–	–	3	3	–	–	–	–	–	–	very eroded, most likely *C. pepo*
76	17	–	1*	–	2	–	–	–	–	–	–	–	eroded frag., most likely *C. pepo*
KvD	498*	–	4*	–	19	7	60	–	5	15	–	–	7 thin and curled rinds—'wild';
Total	800	4	5	–	98	14	60	–	5	15	–	–	peduncle frag., most likely *C. pepo*
EPIII													
1	14	–	–	–	–	–	–	3	–	3	–	–	
29	421	–	7*	–	11	13	–	–	8	–	–	–	eroded, most likely *C. pepo*
77	39	–	–	–	–	–	–	–	–	–	–	–	
Total	474	–	7	–	11	13	–	3	8	3	–	–	
MPIII													
31	103	14*	–	–	15	2	–	–	1	–	–	–	very eroded, most likely *C. pepo*
LPIII													
1	667*	–	–	–	684	14	15	33	–	28	1	–	25 fragments, could be 'wild'
2	774	–	–	–	11	15	3	–	1	–	–	–	
5	460*	2*	2*	–	57	32	15	1	4	41	–	–	3 rind frags., could be 'wild'; seeds and peduncle = *C. pepo* (?)
18	299	7*	–	–	100	1	1	1	–	3	–	–	eroded, mostly likely *C. pepo*
23	700*	17*	4*	–	25	38	61	2	10	85	–	–	32 rind frags., could be 'wild'; seeds and peduncles = *C. pepo* (?)
25	5	–	–	–	–	1	–	–	–	–	–	–	
26	1	–	–	–	–	–	–	–	–	–	–	–	
27	350	14*	–	–	28	8	–	–	–	–	–	–	eroded, most likely *C. pepo*
29	1083	35*	7*	–	178	37	1	–	11	–	1	–	seeds and peduncles-*C. pepo* (?)
42	5	–	–	–	–	–	–	–	–	–	–	–	
57	3	–	–	–	1	–	–	–	–	–	–	–	
Total	4347	75	13	–	1084	146	96	37	26	157	2	–	
Overall Total	6013	93	38	–	1267	182	156	45	35	175	2	–	

a = refer to Table 40 for proveniences surveyed within rooms
b = R: ring, S: seed; P = peduncle
c = starred (*) remains discussed under comments

earliest phase in which these two species were found at Antelope House. One provenience in Room 67–71 (P1104, dated BMIII) yielded a peduncle, which appears to be *C. mixta*. Rind fragments identified as *Lagenaria siceraria* were found in a PI context in Structures 70 (P194) and 63 (P1105). Structure 70 (P194) also yielded a peduncle of *C. mixta*. These locations were not included in this study because of the absence of maize cobs there; they were not systematically surveyed for other vegetal remains because these were not present in quantity.

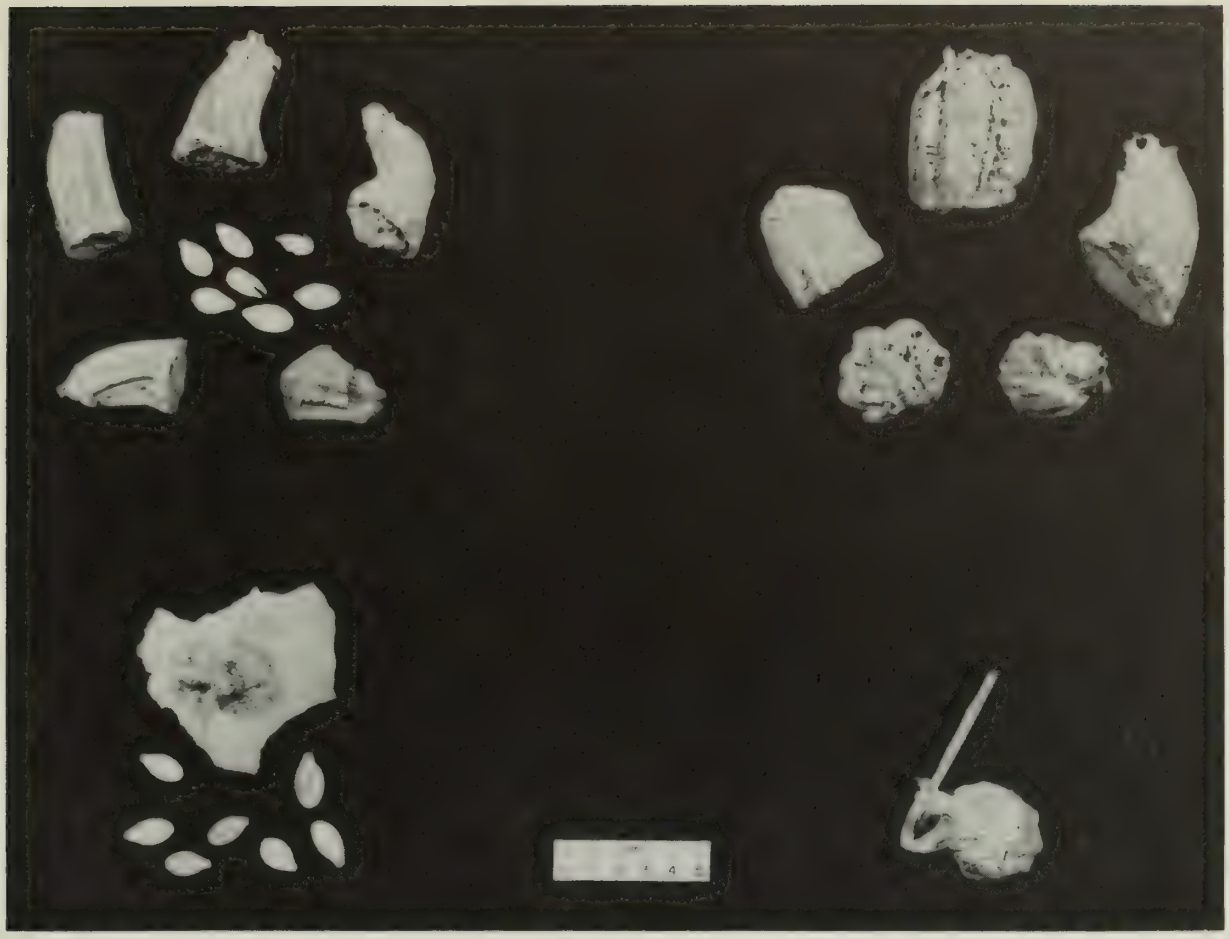


Figure 50. Cucurbits from Antelope House: (clockwise from top left cluster) five peduncles and seven seeds of **C. pepo**, *and five peduncles of* **C. Mista**, *all from Early PIII Room 29 (1318); one peduncle of* **C. mixta**, *and one peduncle and seven seeds of* **C. pepo**, *all from Middle PIII Room 31 (589).*

Early Pueblo III. Seeds and peduncles of both *Cucurbita pepo* and *C. mixta* were found (Fig. 50), as were rind fragments of *Lagenaria*. Seven highly eroded fragments of peduncles from Room 29 were not identified, but they are most likely *C. pepo*, as they appear to lack corky tissue.

Middle Pueblo III. Only two of the three species of cucurbits previously identified (*C. pepo* and *C. mixta*) were identified for this phase, both being represented by seeds and peduncles (Fig. 50). Fourteen seeds were found; while positive identification is not possible, they probably represent *C. pepo*. The main identifying traits have been eroded away.

Late Pueblo III. The largest amounts of cucurbit material were recovered from this phase, which accounted for 72.5 percent of all rinds, 85.1 percent of all seeds and 72.5 percent of all peduncles. The first *Lagenaria* seeds are seen here (Fig. 49) and 17.8 percent of all *C. mixta* seeds come from this phase. Sixty rind fragments, which possibly are wild rather than cultivated, were recovered from Rooms 1, 5 and 23. The unidentified seeds and peduncles of Cucurbita can probably be placed with *C. pepo*, although concrete identification was not possible. A mass of placental *C. pepo* tissue with imbedded seeds was recovered from Room 1. Two of the upper

proveniences in Room 1 (071 and 079) showed evidence of modern intrusion, as seeds of *Citrullus vulgaris* (watermelon) also were found. Neither provenience yielded peduncles, but they did contain three seeds of *C. pepo* and five unidentified rind fragments, which probably are *C. pepo*.

Cutler and Whitaker date the arrival or use of *C. mixta* in Canyon del Muerto between AD 1251 and 1284 at Mummy Cave. The appearance of *C. mixta* at Antelope House during PII pushes the appearance of this cucurbit back in time. At Gourd Cave in Arizona, a site with uncertain dating, *C. mixta* probably appeared during the late 900's or early 1000's. The earliest appearance of this species is at Ventana Cave (AD 900); in Walnut Canyon, Arizona, *C. mixta* dated AD 911 to 1242 has been found. Numerous sites in Glen Canyon in Arizona and Utah date *C. mixta* finds between AD 1050 and 1250. Other than the Mummy Cave date, the appearance of *Cucurbita mixta* at Antelope House is temporally comparable to its appearance in sites to the west.

As previously mentioned, remains of the bottle gourd (*Lagenaria siceraria*) were recovered in a PI context at Antelope House. At Mesa Verde, bottle gourd from Step House is dated AD 610, from Bone Awl House at AD 958–1187 and from Square Tower House at AD 1066–1246. The dates for recovery of bottle gourd at Antelope House, then, compare favorably with those for the recovery of this species at other Anasazi sites. If more BMIII and PI material had been recovered at Antelope House, earlier finds of cucurbits would probably have resulted.

Cotton

The results of measurements taken from modern varieties of *G. hirsutum* are presented in Table 46. Comparison of mean estimated lock numbers for each type of cotton (de Chelly, Sacaton and Moenkopi) showed no statistical difference between them; these means agree well with the actual mean lock numbers. In all cases the estimated lock number is in agreement with the actual number, but is somewhat lower. These estimates, then, seem to give an accurate measure of the true values.

The calculated s/r ratios again are statistically similar to the theoretical ratios and also appear to be good bases of comparison for use in identifying cotton types.

There is no difference statistically between the mean boll indices of Sacaton and Moenkopi cotton, but the mean index for the de Chelly cotton differs significantly from these. This would indicate an environmental influence on the growth of the Sacaton cotton, in that the bolls become more rounded under the environmental conditions in the area of Antelope House.

The de Chelly cotton has seeds which show no statistical difference from those of Sacaton cotton. There appears to be no discernible environmental influence on seed size. Both of these cotton types have larger seeds than does the Moenkopi type and this size difference is statis-

Table 46. Data derived from modern crops of *Gossypium hirsutum* var. *punctatum*.

Type[a]	Lock No.	Estimated Lock No.	s/r Ratio	Boll Index	No. Bolls	Seed Grade	No. Seeds
dCh	3	2.92 ± .15	2.16 ± .12	75.12 ± 3.28	6	6.11 ± .08	40
dCh	4	3.95 ± .31	1.60 ± 1.20	81.65 ± 1.75	1	5.88 ± .15	20
Mean	3.14 ± .53	3.07 ± .55	2.08 ± .30	76.05 ± 3.49	7	6.03 ± .15	60
HSa	3	2.98 ± .13	2.14 ± .10	83.34 ± 3.24	16	6.11 ± .10	40
HSa	4	3.80 ± .09	1.66 ± .04	89.20 ± 2.10	20	5.83 ± .13	138
HSa	5	4.94 ± .27	1.27 ± .07	103.07 ± 12.42	3	6.09 ± .04	26
Mean	3.67 ± .72	3.55 ± .66	1.83 ± .33	87.86 ± 6.09	39	5.92 ± .15	204
HMo	4	3.94 ± .05	1.60 ± .02	85.58 ± 1.88	20	5.60 ± .05	157
HMo	5	5.02 ± .08	1.25 ± .02	97.83 ± 3.02	18	5.53 ± .07	98
Mean	4.47 ± .72	4.45 ± .77	1.43 ± .25	91.38 ± 8.77	38	5.58 ± .06	255

a: dCh = Hopi Sacaton cotton grown at Canyon de Chelly NM in 1973
HSa = Hopi Sacaton cotton grown at the University of Arizona in 1972
HMo = Hopi Moenkopi cotton grown at the University of Arizona in 1972
Calculations given as the mean ± 2SE

tically significant. All of these seeds are tufted rather than fuzzy.

The Moenkopi cotton had no 3-lock bolls, while the de Chelly type had no 5-lock bolls. Sacaton is intermediate, having 3-, 4- and 5-lock bolls. It would be interesting to see whether the environmental conditions around Antelope House would show an effect on Moenkopi cotton, as they apparently did on Sacaton.

The measurements made on the dry segments of these modern types suggest that they reflect an accurate estimate of both the shape and lock number. This supports the similar statement made by Stephens (1968) concerning comparisons of modern specimens with material recovered from Coxcatlan Cave.

The archeological remains measured are represented by the data in Table 47 and by examples illustrated in Figure 51.

Basketmaker III. The five locks recovered from this context have an estimated lock number of less than three and a boll index similar to that of Sacaton cotton. The one seed found has a seed grade of 5.90, which also compares favorably with the mean for Sacaton cotton, and is tufted like the modern types. The locks have the dark

Table 47. Data derived from remains of *Gossypium hirsutum* var. *punctatum* recovered from Antelope House (mean = ± 2SE).

Period & Location	*Estimated Lock No.*	*s/r Ratio*	*Boll Index*	*No. Locks*	*Seed Grade*	*No. Seeds*
BMIII						
67–11	2.78 ± .35	2.29 ± .29	75.07 ± 9.17	5	5.90 ± .00	1
PI						
70	2.96 ± .43	2.18 ± .28	76.80 ± 6.04	7	5.03 ± .26	2
PII						
KvD	—	—	—	—	5.60 ± .24	3
75	—	—	—	—	4.94 ± .00	1
Mean	—	—	—	—	5.44 ± .47	4
EPIII						
29	—	—	—	—	5.78 ± .61	2
77	—	—	—	—	5.32 ± .30	6
Mean	—	—	—	—	5.44 ± .30	8
MPIII						
31	—	—	—	—	Fiber only	
LPIII						
1	3.06 ± .26	2.09 ± .17	74.00 ± 7.28	181	5.75 ± .17	140
2	2.86 ± .46	2.24 ± .39	63.34 ± 9.29	17	5.94 ± .58	35
5	2.53 ± .38	2.53 ± .38	68.02 ± 3.86	12	5.95 ± .13	150
18	3.10 ± .70	2.07 ± .42	69.18 ± 10.45	4	5.74 ± .32	45
19	3.10 ± .21	2.07 ± .13	74.52 ± 6.92	22	—	—
23	—	—	78.86 ± 4.65	—	—	—
23	2.95 ± .10	2.13 ± .08	66.09 ± 2.45	84	5.67 ± .18	65
25	—	—	—	—	Fiber only	—
26	2.55 ± .00	2.47 ± .00	58.82 ± 0.00	1	5.82 ± .33	3
27	—	—	76.83 ± 9.48	—	—	—
27	3.25 ± .12	1.96 ± .07	66.89 ± 2.97	57	5.81 ± .10	48
29	2.95 ± .14	2.13 ± .10	70.99 ± 9.16	3	—	—
29	4.20 ± 1.21	1.56 ± .47	86.53 ± 29.20	3	5.76 ± .22	34
42	—	—	—	—	Fiber only	
Mean	3.05 ± .11	2.09 ± .01	70.57 ± 2.82	384	5.82 ± .07	519
Overall Mean	3.06 ± .04	2.12 ± .02	70.73 ± 2.58	396	5.80 ± .06	546

Room 23: data from four unopened 3-lock bolls; not included in any other mean data.
Room 77: data from four partial and one unopened 4-lock bolls; not included in any other mean data.
Room 29: data from one open 3-lock boll; not included in any other mean data.

punctuations on the segments seen in Hopi Sacaton. A few small bolls of fiber only were found, with a strand of cotton cord within the fiber.

Pueblo I. The remains of PI cotton consisted of seven locks and two seeds. The mean estimated lock number was greater (2.96) than that found in BMIII materials (2.78), but was not statistically different. Statistically, the boll index was the same as that of BMIII cotton and was similar to both the de Chelly and Sacaton types. The s/r ratio is also statistically similar to that for the BMIII phase. As with the BMIII remains, a small amount of unworked fiber also was found.

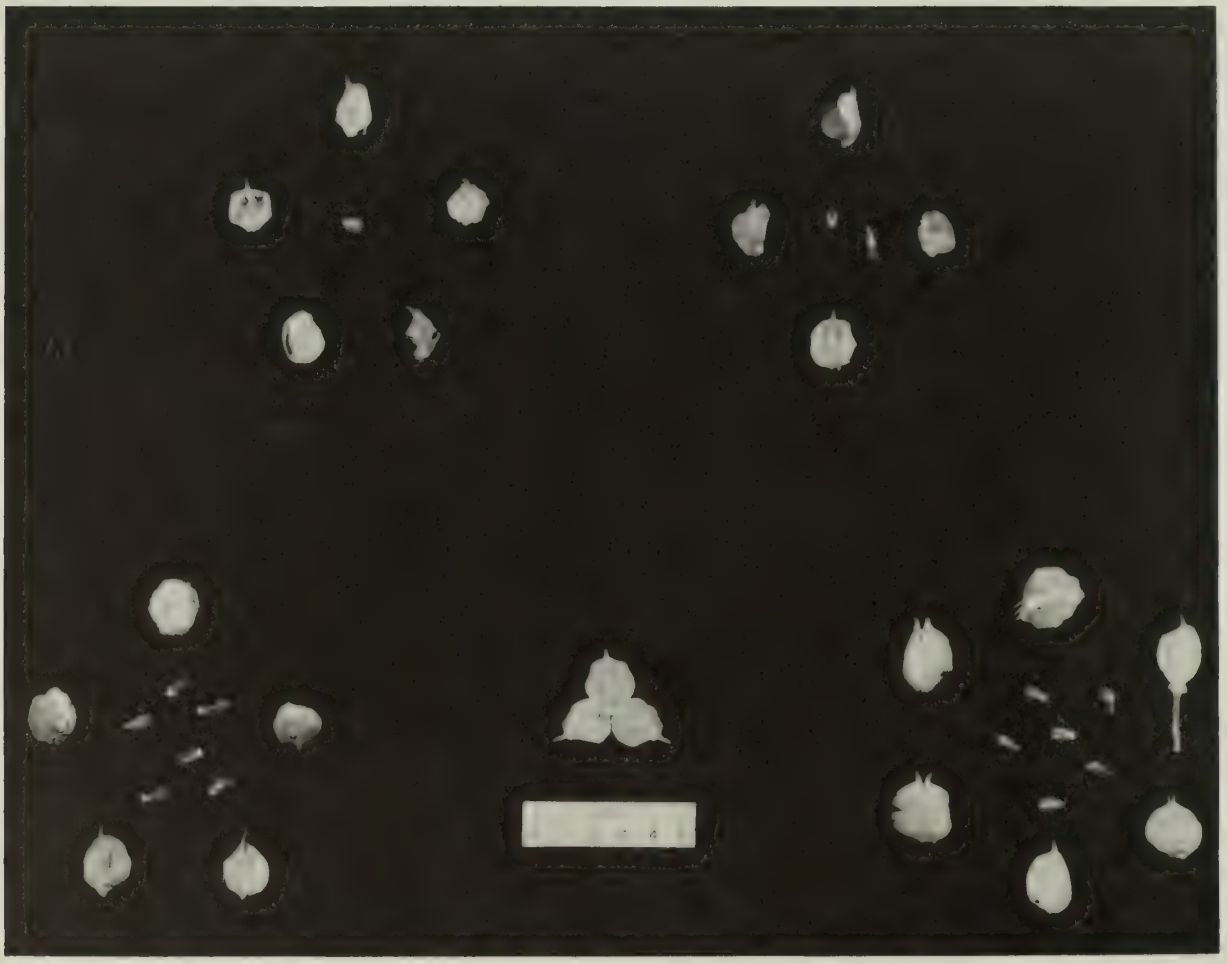
The two seeds, on the basis of seed grade, are smaller than the BMIII materials, but are tufted rather than fuzzy. The reason for the statistical difference is most likely a matter of sample size, rather than a morphogenetic characteristic.

Pueblo II. No bolls or locks were recovered in the locations sampled for this phase. The four seeds found in Kiva D and Room 75, while smaller than those of modern de Chelly and Sacaton cotton, are not statistically different in size and are tufted.

Both Kiva D and Room 75 also yielded remains of fiber, most of which was matted and mixed with other vegetal materials. Some was charred.

Early Pueblo III. The only lock of cotton found in EPIII remains was smashed to such an extent that no reliable measurements were obtainable. Due to the badly eroded condition of this lock,

*Figure 51. Cotton (***G. hirsutum var punctatum***) from Antelope House: (clockwise from top left cluster) five boll segments and a seed from BMIII Room 67 (1103); four boll segments from PI Room 70 (1106); two-thirds of 3-lock boll, 3-lock boll, 3-lock boll plus peduncle, half of a 4-lock boll, a boll segment, half a second 4-lock boll and six seeds from Late PIII Room 27 (245); open 3-lock boll from Late PIII Room 29 (1173); three 3-lock bolls, two boll segments and six seeds from Late PIII Room 23 (1404).*



nothing can be said about the presence or absence of dark punctuations in the outer portion of the segment. Fiber was mixed with unidentified vegetal material and maize tassels.

The eight seeds found had a mean seed grade identical to that of PII cotton and statistically the same size as Moenkopi, but they were significantly smaller than those found in de Chelly and Sacaton cotton.

Middle Pueblo III. A very small amount of unworked fiber, best described as "a pinch," was found. No other cotton remains were recovered.

Late Pueblo III. This phase yielded 95 percent of the seeds and 97 percent of the locks recovered from Antelope House. Only two rooms (25 and 42) yielded no locks or seeds. In both cases the fiber was mixed with other vegetal material and some was charred. The fiber found in the other rooms varied from relatively clean to well mixed with other vegetal material and, in some cases, with cotton seed. Both worked and unworked material was found.

The estimated lock numbers range from a low of 2.53 in Room 5 to a high of 4.20 in Room 29 (Table 47). As in all previous phases, except for one case in Room 29, the mean lock number is low, or basically 3-lock/boll. If the locks found in Room 29 represent material from 3, 4 and 5-lock bolls, then the mean and the standard error are understandable and very close to the expected values. The estimated overall mean for LPIII shows no statistical difference from other phases examined and is compatible with the mean obtained for de Chelly cotton.

The s/r ratios are representative of the value found for mean lock numbers and again reflect a close relationship with de Chelly cotton. About 80 percent of the bolls found in LPIII show the dark glandular punctuations found in de Chelly and Sacaton cotton, while the rest either resemble Moenkopi more closely or are so eroded that an accurate relationship could not be determined.

When comparing the LPIII boll index with those from other phases, only the single boll in Room 26 reflects a mean which is different statistically from these values; that this boll represents a single distorted specimen explains the difference. The basic shape of the LPIII cotton bolls can be described as round to somewhat oval.

The seed size is small and the overall mean value is intermediate between those of Sacaton and Moenkopi cotton. The fact that these seeds have had over 700 years to dry and shrink plays a major role in this finding. Seeds of this type would when fresh, probably have been more nearly like those found in de Chelly cotton.

The importance of differences in lock number and boll index cannot be denied, lock number because it does not change through time in storage and boll index because it reflects the overall shape by combining the measurement so as to minimize the dimensional differences. Stephens (1968) has stated that "measurements made of modern dry segments suggest that estimates of this character from dry segments are reliable." This has held true here when different measurements were made to determine the boll characteristics of modern specimens of de Chelly, Sacaton and Moenkopi cotton. Smith and Stephens (1971) found that archeologically recovered bolls from the Valley of Oaxaca in Mexico differed little from primitive races of *G. hirsutum* found in that area today. This finding holds true for the comparison of archeological cotton from Antelope House with the types of *G. hirsutum* represented by de Chelly, Sacaton and Moenkopi cottons. Further indications of the latter similarity can be found both in the dark punctuations found on the segments and in the seed sizes.

Did the inhabitants of Antelope House grow their own cotton or import it? We know that at least one modern form of *G. hirsutum* will mature in the Canyon de Chelly area today. There is no reason to believe that this was impossible during the Anasazi occupation of the area. That no stems or leaves of cotton were found before LPIII does not mean that cotton was not grown at Antelope House prior to that period. That only seeds were recovered in the PII and EPIII rooms surveyed and that only fiber was found in MPIII areas is, I believe, due to sample size rather than to the absence of cultivation. The small number of bolls representing BMIII and PI can be accounted for in the same way. If cotton was traded for and imported, bolls would not be present. In carrying materials over long distance for trade, the traders would want to carry the maximum usable material. Bolls would be useless for food or for textile manufacturing and would take up space which could be filled with fiber.

Another factor supporting the relationship of Antelope House cotton to *G. hirsutum* var *punc-*

tatum is this: all seeds recovered, except one, were tufted rather than fuzzy. Since Whitney did not invent the cotton gin until the latter part of the 18th century, we are safe in assuming that preconquest cotton was ginned by hand. Under such conditions, seeds which could be held in the fingers of one hand while the fiber was pulled free by the fingers of the other would be the most desirable. Tufted seeds meet this requirement. It could well be that the Antelope House inhabitants or the people from whom they received their first cotton consciously or unconsciously selected for tufted seeds.

Summary

The analysis of cultivated plants grown at Antelope House shows that corn, beans and squash were present, along with cotton, which was important not only for its fiber but also as food. The types of corn, beans and squash are essentially the same as those found at other Anasazi sites in comparable periods. The first two cultivars show their closest relationships to sites north and west of Canyon de Chelly.

Results of the corn analysis (of cobs in particular) tend to show a segregation of the corn into groups on the basis of the row numbers of corn grown through time, particularly in Late Pueblo III. Some evidence for drought was found in the corn of the Middle Pueblo III phase, but this could be due to the scarcity of material rather than to the effects of drought. Modern findings have shown that varieties of cotton similar to that found at Antelope House can grow in the area today. On this basis, it is probable that the ancient inhabitants of the area also grew cotton rather than importing it. The other cultivars are similar to those grown in the area today.

Gathered Plants

Of the 647 varieties of plants found growing in Canyon de Chelly or present in the Antelope House refuse, the ethnographic literature scanned by our botanical team indicated that 224 are potential food plants, that is, they have been recorded as being consumed by humans and as providing known nutritive elements for humans. Predictably, not all of these plants have been recorded from Antelope House; presumably they were not part of the Antelope House diet. Seventy-eight, or 34.8 percent, occur in the archeological deposit, but not all of these necessarily were eaten. The occurrence of the 78 gathered plants throughout the monument should indicate areas and/or plant communities extensively exploited by the population of Antelope House. Appendix F, which identifies each of the 647 taxa found within the monument and summarizes their modern uses and archeological recovery, lists 14 such zones. Table 48 lists the number of plants from each zone found at Antelope House.

The unique plants of several zones (sagebrush, pinyon-juniper and upper rim) apparently were not used, although plants in several zones, such as pinyon and juniper, were heavily relied on. Casual observation indicates that few prehistoric sites are located in sagebrush areas. Sites are abundant in the pinyon-juniper and upper rim areas, however, suggesting that the sagebrush community generally was of little significance to the inhabitants of Canyon de Chelly.

In general, the likelihood that a plant will occur in the archeological deposit at Antelope House increases as the plant becomes more widespread in the monument; a plant with restricted distribution is less likely to be recovered from the site. The most heavily exploited zones are those closest to Antelope House, with no evidence suggesting distant gathering or exchange with groups closer to sagebrush and upper rim areas. It would be interesting to determine whether sites in the upper canyon area show a comparable close adjustment to the local

Table 48. Numbers of wild food plants and zone from which gathered.

Canyon Zone	*Number at Site*	*% at Site*
Monument (general)	8	72.7
Middle bottom	11	47.8
Middle rim	6	46.2
Talus	5	41.6
Lower bottom	19	40.4
Rims	6	40.0
Wet places	10	37.0
Bottom	4	30.7
Disturbed areas	2	28.5
Upper bottom	10	26.3
Lower rim	4	23.5
Grassland	2	20.0
Pinyon-Juniper	0	0.0
Sagebrush	0	0.0
Upper rims	0	0.0

plant communities. It is surprising that of the potential food plants growing in disturbed places, only two were found at Antelope House, since one category of disturbed places includes fields, borrow pits and other areas where collecting of plants and experimentation with their food values would have been easy.

It is worth noting that the canyon bottom, in general, provides more plant species suitable for food than do any of the other areas. This observation adds weight to the argument that human populations would concentrate in the canyon during times of environmental stress.

Presented below are findings from our observations of the vegetal trash that are rarely reported in the ethnobotanical literature.

Amaranthus

The vegetal remains of *Amaranthus* spp. found at Antelope House consist of the following three types: (1) seeds, occasionally including floral structures, from flotation; (2) broken pieces of stem, often including parts of the lateral inflorescences, with mature fruits and seeds; and (3) one Navajo seed cache. The mature, undamaged seed material from flotation is of two different size ranges and each has been assigned to a separate species. The Navajo seed cache contains only seeds of the larger size.

The average diameter of the larger (1.5 mm) falls within the 1.3 to 1.6 mm range given by Correll and Johnston (1970: 560) for the spreading, or prostrate, pigweed (*Amaranthus blitoides* Wats. = *A. graecizans* L. of Kearney and Peebles 1960: 266) and approximates the average diameter (1.55 mm) of a modern collection of this species from Canyon del Muerto. The average diameter of the smaller (1.1 mm) falls within the 1.0 to 1.2 mm range given by Correll and Johnston (1970: 559) for *A. powellii* Wats. Because no other amaranth known to occur in northeastern Arizona (McDougall 1973: 156–157; Kearney and Peebles 1960: 266–267) approaches the large size of *A. blitoides*, the seed alone is diagnostic. At least one other species (*A. hybridus* L.) reported to occur in the monument (Halse 1973: 84) has a seed size of 1.1 to 1.3 mm (Correll and Johnston 1970: 559), which overlaps with that of *A. powellii*. The seeds and stem parts from Antelope House are believed to be *A. powellii* because: (1) the few intact flowers with mature seeds in the archeological material have tepals between 2.3 and 2.8 mm long, whereas *A. hybridus* is reported to have tepals from 1.5 to 2.0 mm (Correll and Johnston 1970: 559; McDougall 1973: 157); (2) the tepals vary in number from three to five, with four uncommon, and this trait is reported to occur with frequency only in *A. powellii* (Sauer 1967: 108); and (3) according to Sauer (1967: 108–109), *A. hybridus* "is evidently a native riverbank pioneer of milder and moister regions from eastern North America through Mexico. . .," whereas *A. powellii* "is a pioneer of canyons, desert washes, and other open habitats, ranging through the western Cordilleran system of North America . . . the species has long been a common weed in the West. . ." Therefore, *A. powellii* is the native western plant that would be expected to occur prehistorically.

It is interesting to note that Jones and Fonner (1954: 94–95) found amaranth seeds of two different sizes (ca. 1.0 mm and 1.5 mm) in Basketmaker II sites in southwestern Colorado. It is possible that these seeds are from the same two species occurring at Antelope House, since this area is only about 240 km distant. Both species occur in Colorado at elevations ranging from 1220 to 2290 m (4000–8500 ft.), although Harrington (1954: 217) lists *A. blitoides* as *A. graecizans* and *A. powellii* is treated as a synonym for *A. retroflexus*. Considerable confusion has existed in the identification of amaranth species, due in part to the ability of many species to produce partially fertile hybrids. A revision (Sauer 1967: 103–137) of the grain amaranths (Sauer 1950: 561–632) and their relatives provides a key to 15 species and an extended discussion of the three domesticated species. One of the latter, *A. hypochondriacus*, "evidently derived mainly from *A. powellii* . . ." (Sauer 1967: 111), was recovered from Tonto National Monument by Bohrer (1962: 107–109) and according to Sauer (1967: 103) is "the first material evidence of pre-Columbian grain amaranth cultivation in North America." Bohrer (1962: 107–108) recovered three "fragmentary heads. . .," two of which had the ivory-colored seeds associated with the cultivated grain amaranths (Sauer 1967: 110). No material with pale seeds was found at Antelope House, although some specimens exhibit the generally shorter bracts associated with the grain amaranths.

Atriplex

Most of the identified material consists of

fruits of *Atriplex canescens*, the four-wing saltbush. One leaf of an *Atriplex* sp. appears to resemble *A. confertifolia* more closely than *A. canescens*. Both species occur in the canyon today (Halse 1973: 80–81). It is quite probable that stems of either of these two species have been misidentified as *Sarcobatus vermiculatus*, whose wood is similar. It is not probable that any *S. vermiculatus* was misidentified as *Atriplex* sp., however. The usually round branch scars with a single branch and the often irregular shape of the stem in cross section of *Atriplex* sp. contrast with the usually elongate scars with two to several branches at a node in *Sarcobatus vermiculatus*. These distinctions were not recognized until very late in the sorting procedure. The wood of the two *Atriplex* spp. and that of *Sarcobatus vermiculatus* have a very distinctive mottled appearance in cross section.

One very well preserved specimen, a tied bundle of whole plants from LPIII, was identified as *Atriplex jonesii*.

Celtis Reticulata (Hackberry). The remains are primarily seeds. There is one sample each of stem and leaf. Most of the seeds appear to have been gnawed and it is quite possible that they occur in the site via pack rat transport. All but one of 15 occurrences are from LPIII or Navajo proviences.

Celtis reticulata trees are scattered in the lower parts of the canyon system, and in Del Muerto they occur as far upstream as the mouth of Pine Tree Canyon just above Mummy Cave. They are nowhere abundant today.

There is no good evidence that the fruits of *Celtis* were used as food by the residents of Antelope House.

Sclerocactus. *Sclerocactus whipplei* remains from Antelope House most often consist of the shriveled basal portion of the small (ca. 4–8 cm), ovoid, papillate plant with the spines removed. The cactus has a somewhat woody central core, which also is often found. Its appearance is of a plant whose mild-flavored, softer upper and inner parts have been eaten away and whose tougher core, lower parts and upper root has been discarded. Occasional plants with spines and masses of detached spines occur in the vegetal remains.

Because the shape, number and arrangement of the spines is unique, there is no uncertainty about the identification of this plant as *Sclerocactus whipplei*. The species, though inconspicuous, is present locally today (Halse 1973: 128) and all living specimens seen by us at de Chelly appear to belong to the "yellow" (actually greenish yellow) flowered *S. whipplei* (Englem and Bigelow) Britt and Rose var *whipplei* (Benson 1969: 176–178). One might assume that the archeological remains are from this variety and this could be true. In the case of 30 areoles recovered from Room 1, Provenience 331 (Late Pueblo III), the upper, flattened central spine varies from 1.1 to 2.4 mm wide, averaging 1.56 mm. This figure falls at the lower limit of *S. whipplei* var *whipplei* and the upper limit of *S. whipplei* var *intermedius*, which is given as 1/16 inch (1.6 mm) by Benson (1969: 176). It is quite possible that the archeological material contains specimens of both varieties. A present distribution map (Benson 1969: 178) shows *S. whipplei* var *intermedius* occurring in the Black Mesa region of Navajo County, Arizona, not more than 80 km west of Canyon de Chelly.

This, to our knowledge, is the first record of a *Sclerocactus* sp. being recovered in an archeological context and its use can only be inferred. Because it appears to have been eaten, one might assume that it served as a food, as did the species of *Opuntia* found in the canyon, but there are several arguments against this assumption. It is a small plant, ca. 6 cm in diameter, and would have to have been gathered in vast quantities to provide significant food. It is a very inconspicuous cactus and even when one knows where to look it is difficult to find. It is not plentiful today and if its distribution in the past was about the same, it could not have provided very much in the way of food. Finally, its method of gathering, uprooting the whole plant, would soon decimate the population.

If, however, it was used as a ceremonial plant, there might have been tight restrictions on its gathering and use, so that the populations could maintain themselves via seed dispersal. One argument in favor of this view is that the species contains a very small amount of mescaline and at least two other unnamed alkaloids, as determined by chemical analysis of a specimen originally from the Holbrook area of Arizona. This specimen was donated by Archie Deutschman and the analysis was made by Mary Angela Ott in the University of Arizona chemistry laboratory of Cornelius Steelink. Unfortunately, the

scattered distribution of *Sclerocactus* remains in Antelope House give no indication of association with kivas or any other ceremonial structure or artifact. The remains occur from Pueblo I through Pueblo III and a little (4.7 g) in a Navajo provenience, indicating a tradition of use spanning about 400 years. The Navajo foreman of the dig at Antelope House, Chauncey Naboyia, was asked if he knew of any use of any cactus for ceremonial purposes and he answered no, that cactus was used only as "cow feed." Considering the bad image that hallucinogens have had, it is possible that he would not divulge their current use, if any.

The small amount of mescaline found in the analyzed specimen of *Sclerocactus whipplei* compares with the amount found in *Peledyphora anselliformis*, a "peyote" cactus from San Luis Potosi, Mexico (Neal *et al.* 1972: 1133). At this low concentration, it is questionable whether the mescaline in *Sclerocactus whipplei* could have caused any hallucinogenic effects. Neal *et al.* (1972: 1133: footnote 23) note that "the possibilities still exist that geographical, seasonal, and strain variations might affect the amount of alkaloid accumulated." It may be that *Sclerocactus* in de Chelly contains larger amounts of mescaline than did the Holbrook specimen analyzed, but a single specimen (ca. 7 cm diameter) eaten fresh did not induce any noticeable effects, nor did another specimen eaten by another project member produce unmistakable hallucinations.

Several questions come to mind concerning this plant. What time of year was it gathered? No flowers or seeds have been found which might indicate an early, prior to flowering (March to April), or later (August to October), after fruiting, time of gathering. Was the plant dried and stored for use? Dried whole, or nearly whole, plants were found, but no other indication of storage, such as tied bundles, was found. How were the spines removed and what kind of an instrument might have been used to do so? The Anasazi do not seem to have burned them off, since many unaltered areoles with whole spine clusters attached are common. A few charred plants, spines removed, have been found. Were the plants cooked? Or were these few plants burned by accident?

Pediocactus

One specimen, consisting of the eroded caudex, was found, but due to its similarity to eroded remains of *Sclerocactus whipplei*, others might have been misidentified. Because of its eroded condition, it is placed in the genus *Pediocactus* only because of its small size and its resemblance to an illustration of *Pediocactus bradyi* in Benson (1969: 182). No species in this genus is now known to occur within 160 km of Canyon de Chelly (Benson 1969: 184). These plants are very inconspicuous and some may occur nearer de Chelly, or might have in the past.

The occurrence of two small cacti in the vegetal remains at Antelope House should spur others to take a closer look at vegetal material to try to determine whether a tradition of "peyotism" did exist in the Anasazi culture and, if so, from whence it came. Nothing is known about the chemistry of *Pediocactus*, as it was little known until the 1950's.

There is a naturally occurring small cactus in the Canyon de Chelly area, *Coryphantha vivipara*, that was not found in the vegetal trash. It differs from *Pediocactus* in being generally larger and sitting on top of the ground; that is, it lacks the underground root-stem structure of *Pediocactus*.

Chapter 12

The Avian Remains

Avifauna from Antelope House consists mainly of large Indian domestic turkeys. Some of these apparently were eaten, but most were raised for their feathers, as indicated by an abundance of turkey feather artifacts (particularly cordage) and by the presence of feathers of three aberrant colorations (erythristic, silver phase and pied), which occur in unusual numbers. Although a predominance of turkeys is reminiscent of the San Juan area, Antelope House avifauna is evidence of an independent and important center of domestic turkey development.

Condition of the Collection

Feather specimens are in an excellent state of preservation and show little, if any, fading. Some show signs of burning or scorching, which appear to be accidental. The vanes of others are partly eaten by insects and some rachices are pierced by insect borings.

Only part of the feather sample was studied. Experience has demonstrated that a sample in excess of 8500 seldom produces additional species in sufficient numbers to be statistically relevant. By the time the total of 11,167 feathers identified was reached, the repetitive nature of the collection was apparent and the remaining time was spent studying all of the bone sample.

In contrast to the generally excellent condition of the feathers, the bird bone collection is extremely fragmentary. Most of the specimens have been gnawed by carnivores, presumably the dogs kept by Antelope House residents. A medium-sized dog can destroy the desiccated carcass of a turkey-sized bird in a few minutes. Bird bone is so fragile that little beyond splinters of leg bone emerges in the feces. For these reasons, I doubt that the collection includes bones of even 20 percent of the turkeys which once lived at Antelope House and probably not much more of those of the wild birds carried in during its occupation.

Although bird bone is fragmentary, what little remains is uniformly well preserved, much of it with the periosteum and tendons still attached. Bone artifacts are shaped for use without being cleaned of this tissue, a condition commonly found among artifacts from caves and rock shelters.

Identification Studies

Tables 49 through 52 summarize the results of identification studies. The collection includes bird bone yielding a Minimum Faunal Count of 479, 23 bird bone artifacts; 11,171 loose feathers; 349 specimens of cordage; 47 additional feather artifacts; and 11 samples of eggshell.

Approximately 20 species of sparrow are found in the vicinity of Antelope House during the course of a year. The rock shelter in which Antelope House is located is an attractive nesting site for various raptors. It was agreed at the beginning of the investigation that since it is com-

Table 49. Levels of avian identification (degree of refinement of identification is indicated by indentation to the right).

Aves	1 class
Anatinae	1 subfamily, 5 species
Aythinae	1 species
Cathartidae	1 species
Accipitridae	1 genus, 5 species
Falconidae	2 species
Tetraonidae	1 family
Phasianidae	1 species
Meleagrididae	2 subspecies
Gruidae	1 subspecies
Columbidae	1 species
Psittacidae	1 species
Strigidae	1 family, 4 species
Capramulgidae	1 species
Picidae	1 species, 1 subspecies
Passeriformes	1 order
Corvidae	1 genus, 4 species
Troglodytidae	1 species
Mimidae	1 species
Turdidae	1 species
Icteridae	1 species
Fringillidae	1 species
Total	43
Summary	
Classes	1
Orders	1
Families	2
Subfamilies	1
Genera	2
Species	32
Subspecies	4
Total	43

mon knowledge among both archeologists and ornithologists that raptors often carry sparrows and other sparrow-sized passerines into rock shelters for food, it would not be economically feasible to treat specimens which gave evidence of arising from this source.

Notes on the Collection

Unidentified Remains

Several feather artifacts and other bird remains could not be identified, or could be identified only to order.

Aves sp.: unknown bird (feather artifacts, 4 [4.51 percent]). eggshell, 1 [9.09 percent]). Artifacts include three feathers, the rachis of each tied with cordage, bent back upon itself and again tied with cordage, and seven tassels of feathers, probably the rectrices of passerines, fastened into one unit. The eggshell specimen is badly eroded and retains no identifying characters.

Passeriformes sp.: perching birds (feather artifacts, 1 [2.13 percent]. The tails of perching birds were tied into tassels; these are unidentified because insects have eaten the vanes, leaving only the rachises.

Ducks

With one exception, remains from ducks found at Antelope House appear to derive from dabbling ducks, implying a shallow-water environment. All of the identified species are still common fall migrants; some breed in the San Francisco Mountains or along the Mogollon Rim (Phillips, Marshall and Monson 1964: 12–14, 16).

Feather remains indicate that the green-headed males of the subspecies *Anas platyrhynchos platyrhynchos* (mallard) were present in the area, rather than the female-plumaged Mexican duck (*Anas platyrhynchos novimexicana*). Mallards prefer ponds and lakes, whereas Mexican ducks are more often found along southern rivers. We should look for the source of the Antelope House ducks in neighboring high mountain lakes, as we have no information suggesting lakes or ponds along the stream courses in the canyons.

Anatinae sp.: dabbling duck (feathers, 14). Dabbling duck feathers include contours from various parts of the body, suggesting that whole ducks, or at least whole duck skins, were carried in, rather than just a few selected feathers.

Anas platyrhynchos platyrhynchos: mallard (Minimum Faunal Count, 5 [15.15 percent of wild birds]; feathers, 2). Mallard bones are from the axial skeletons and wings of three females and two males. Feathers are from the breast of a male.

Anas strepera: gadwall (feathers, 2). Both gadwall feathers are left primaries.

Anas carolinensis: green-winged teal (Minimum Faunal Count, 1 [3.03 percent of wild birds]). Green-winged teal is identified from the slightly fragmentary femur of a male.

Mareca americana: American widgeon (Minimum Faunal Count, 1 [3.03 percent of wild birds]). The American widgeon is identified from a pelvis and four vertebrae.

Spatula clypeata: shoveler (feather artifacts, 1

Table 50. Avifauna recovered and in what form.

Latin Name	*Common Name*	*Unworked Bone*	*Bone Artifacts*	*Unworked Feathers*	*Feather Artifact*
Aves sp.	unidentified bird			x	
Anatinae sp.	dabbling ducks			x	
Anas p. platyhrynchos	mallard	x		x	
Anas strepera	gadwall			x	
Anas carolinensis	green-winged teal	x			
Mareca americana	American widgeon	x			
Spatula clypeata	shoveler			x	
Bucephala albeola	bufflehead	x			
Cathartes aura	turkey vulture			x	
Accipiter cooperi	Cooper's hawk			x	x
Buteo sp.	buteonine hawk	x		x	x
Buteo jamaicensis	red-tailed hawk	x		x	x
Buteo swainsoni	Swainson's hawk	x			
Aquila chrysaetos	golden eagle	x	x	x	
Haliaeetus leucocephalus	bald eagle			x	
Falco peregrinus	peregrine falcon	x			
Falco sparvarius	sparrow hawk			x	
Tetraonidae sp.	grouse or prairie chicken	x			
Callipepla squamata	scaled quail			x	
Meleagris gallopavo	Indian domestic turkey	x	x	x	x
Grus c. canadensis	lesser sandhill crane	x	x		
Zenaidura macroura	mourning dove			x	
Ara macao	scarlet macaw			x	x
Strigidae sp.	medium-sized owl	x			
Otus asio	screech owl	x			
Bubo virginianus	great horned owl	x		x	x
Glaucidium gnoma	pygmy owl	x			
Speotyto cunicularia	burrowing owl	x			
Chordeiles minor	common nighthawk	x			
Colaptes auratus collaris	red-shafted flicker	x		x	x
Sphyrapicus varius	yellow-bellied sapsucker			x	
Passeriformes sp.	perching birds				x
Aphelocoma coerulescens	scrub jay			x	
Pica pica	black-billed magpie	x			
Corvus sp.	raven or crow			x	x
Corvus corax	common raven	x		x	x
Corvus cryptoleucus	white-necked raven	x			
Troglodytes aedon	house wren				x
Oreoscoptes montanus	sage thrasher			x	
Sialia mexicana	western bluebird			x	x
Euphagus cycanocephalus	Brewer's blackbird			x	
Cholura cholura	green-tailed towhee			x	

Table 51. Minimum faunal count of wild birds from bones, by period.

Name	*PI*	*PII*	*PIII*	*EPIII*	*MPIII*	*LPIII*	*Navajo*	*Date Unknown*	*Total*
Anas platyrhynchos						4		1	5
Anas carolinensis	1								1
Mareca americana								1	1
Bucephala albeola						1			1
Buteo sp								1	1
Buteo jamaicensis					2	1			3
Buteo swainsoni						1			1

continued

Table 51. Minimum faunal count of wild birds from bones, by period—Continued

Name	*PI*	*PII*	*PIII*	*EPIII*	*MPIII*	*LPIII*	*Navajo*	*Date Unknown*	*Total*
Aquila chrysaetos								1	1
Falco peregrinus		1	1						2
Tetraonidae sp								1	1
Grus c. canadensis								1	1
Strigidae sp								1	1
Otus asio								1	1
Bubo virginianus		2				1		1	4
Glaucidium gnoma	1								1
Speotyto cunicularia						1			1
Chordeiles minor								1	1
Colaptes auratus collaris								1	1
Pica pica		1							1
Corvus corax	1					2			3
Corvus cryptoleucus							1		1
								Total	33

Table 52. Feathers of wild and captive birds, by period.

Species	*PI*	*PII*	*PIII*	*EPIII*	*MPIII*	*LPIII*	*Navajo*	*Date Unknown*	*Total*
Anatinae sp	1	1		1	4	3		4	14
Anas p. platyrhynchos						2			2
Anas strepera					1			1	2
Spatula clypeata						1			1
Cathartes aura					1	2			3
Accipiter cooperi						1			1
Buteo sp						7		14	21
Buteo jamaicensis						1		2	3
Aquila chrysaetos					1	2		2	5
Haliaeetus leucocephalus								1	1
Falco sparvarius						1		2	3
Callipepla squamata								1	1
Zenaidura macroura						1		2	3
Ara macao		2		5				5	12
Bubo virginianus				4		7		2	13
Colaptes auratus collaris	3					3		6	12
Sphyrapicus varius						2		1	3
Aphelocoma coerulescens						8		6	14
Corvus sp						3		1	4
Corvus corax					2	7		2	11
Oreoscoptes montanus							1		1
Sialia mexicanus	1			3	1	11		2	18
Euphagus cyanocephalus	1					4		1	6
Cholura cholura	2								2
	8	3	0	13	10	66	1	55	156
Turkey Feathers	409	1,939	15	896	1,983	3,253	12	2,508	11,015
Total Feathers	417	1,942	15	909	1,993	3,319	13	2,563	11,171
1 specimen = %	.2398	.0515	6.6667	.1100	.0518	.0301	7.6923	.0390	
% of total feathers for each period	1.92	.15	.00	1.43	.52	1.99	7.70	2.15	
Turkey Feathers	98.60%								
Wild Bird Feathers	1.40%								
	100.00%								

[2.13 percent]). The left primary of a shoveler, which either was scorched accidentally or was deliberately shaped with heat, was found in the fill of a clay-lined pit in Room 28.

Bucephala albeola: bufflehead (Minimum Faunal Count, 1 [3.03 percent of wild birds]). The only diving duck, it is often found in small numbers or alone in small lakes. The fragmentary humerus is from a large male.

Vultures

Vultures are resident in northeastern Arizona between late March and early October (Phillips, Marshall and Monson 1964: 18).

Cathartes aura: turkey vulture (feathers, 3). Turkey vulture is represented by two left primaries and the stripped vane of a flight feather.

Hawks, Eagles and Falcons

Hawks, eagles and falcons are not nearly so numerous in sites in the general Four Corners area as they are along the Mogollon Rim or the Eastern Periphery of this period, but they do occur in consistent small numbers.

Accipiter cooperi: Cooper's hawk (feathers, 1; feather artifacts, 1 [2.13 percent]). This hawk may account for some of the passerines carried into Antelope House as prey. Specimens include fragments of a rectrix and a split wing feather, probably a primary.

Buteo sp.: buteonine hawk (Minimum Faunal Count, 1 [3.03 percent of wild birds]; feather artifacts, 6 [12.77 percent]). Buteonine hawk bone consists of a fragmentary claw. Feathers include a countour, a vane and 19 flight feathers, from most of which the vanes have been stripped, leaving only the rachises. The six feather artifacts are fletching; hen feathers are dark and cock feathers are spotted.

Buteo jamaicensis: red-tailed hawk (Minimum Faunal Count, 3 [9.09 percent of wild birds]); feathers, 3; feather artifacts, 1 [2.13 percent]). Red-tailed hawk is represented by two right carpometacarpi and a left ulna. The feathers are from the wings and the tail. A right rectrix has the outer vane stripped, as if for fletching. Although red-tailed hawks are common residents, especially during the winter months, they constitute an unusually low percentage of the collection. However, if the *Buteo* sp. are included, as is most probable, their frequency is more what one would expect in this area.

Buteo swainsoni: Swainson's hawk (Minimum Faunal Count, 1 [3.03 percent of wild birds]). The right ulna and carpometacarpus of a large female Swainson's hawk found in Kiva B Annex may be the remains of a feather fan. It is noteworthy that all bones of buteonine hawks are from the wings or feet, portions often used for adornment or ceremonial paraphernalia.

Aquila chrysaetos: golden eagle (Minimum Faunal Count, 1 [3.03 percent of wild birds]; bone artifacts, 1 [4.35 percent]; feathers, 5). Golden eagle bone consists of the ungual of an immature bird. A well-polished tube cut from the ulnar shaft of a large eagle also has been labeled golden eagle. Golden eagles are more common than bald eagles in pleistocene deposits, in archeological sites and at the present time. They are fairly general in distribution, whereas bald eagles are rare and usually are limited to the vicinity of lakes and watercourses. The golden eagle feathers are from the wings and the tail. One has been stripped.

Haliaeetus leucocephalus: bald eagle (feathers, 1). The only specimen identified as bald eagle is the rachis of a right primary.

Falco peregrinus: peregrine falcon (Minimum Faunal Count, 2 [6.06 percent of wild birds]). Peregrine falcon, represented by an articulated right coracoid and scapula and the distal end of a right tibiotarsus, should have been a summer resident in the area.

Falco sparvarius: sparrow hawk (feathers, 3). This tiny falcon is found in Southwestern archeological sites of all periods. Feathers identified are an upper wing covert, a left initial secondary and a right terminal secondary, all from females.

Grouse and Quail

Blue grouse (*Dendragapus obscurus*), the only grouse now known in Arizona (Phillips, Marshall and Monson 1964: 27–28), is present in the Chuska Range. The distal shaft of a left tibiotarsus may represent this species.

There has long been considerable disagreement about the aboriginal presence or absence of Gambel's quail and scaled quail in northeastern Arizona. Gambel's quail, reported in the area in the early 1900's, is believed by some to have been introduced. Be that as it may, reason indicates that the area was originally much grassier than it is today and that the grassloving scaled quail would be present. As herds denuded the area in the recent past and as brush has moved

in some areas, Gambel's quail, whether by natural dispersal or by deliberate introduction, would be the species able to survive, at least for a short period, in such an environment. The presence of a scaled quail feather at Antelope House reinforces our suggestion that if any quail were present in northeastern Arizona in prehistoric times, it should have been the scaled quail.

Tetraonidae sp.: grouse or prairie chicken (Minimum Faunal Count, 1 [3.03 percent of wild birds]).

Callipepla squamata: scaled quail (feathers, 1). The scaled quail is identified from a clearly marked breast feather.

Turkeys

No indication of wild turkeys was noted in the Antelope House collection; considering that turkeys had been domesticated in the area for a considerable period before Antelope House was built, the pueblo's inhabitants had little need of them.

An adult male and three adult females are definitely separable from the main body of large Indian domestics. Two others, both adult males, also are suspect and probably should be considered small Indian domestics, in spite of their very fragmentary condition.

Distribution of Antelope House turkeys by age, sex and period is summarized in Table 53. Most Antelope House turkeys grew up and lived into old age. Immature and young adult deaths can probably be attributed to their use as food, based on the appearance of the specimens recovered. The totals of 220 for males and 204 for females reflect no marked preference for one sex over the other; all turkeys apparently were considered valuable. Males, however, produce more feathers and might be saved from food use for that reason. Immature and young adult totals of 26 for females and only 16 for males lend some support to this hypothesis.

Meleagris gallopavo: Indian domestic turkey (Minimum Faunal Count, 446 [93.12 percent]; bird bone artifacts, 21 [91.30 percent]; feathers, 11,015; feather cordage, 349 [100 percent]; feather artifacts other than cordage, 22 [46.81 percent]); eggshell, 10 [90.91 percent]. As is all Antelope House bone, turkey bone is badly chewed, presumably by the resident dogs, and very few spec-

Table 53. Minimum faunal count of turkeys from bone, by age, sex and period.

	BMIII	*PI*	*PII*	*PIII*	*EPIII*	*MPIII*	*LPIII*	*Navajo*	*Date Unknown*	*Group Total*
Males										
old	—	—	—	—	—	1	2	—	—	
adult	—	9	19	2	15	34	100	1	21	
young adult	—	—	2	—	1	—	1	—	—	
immature	—	—	1	—	—	2	7	—	2	
Total Males	0	9	22	2	16	37	110	1	23	220
Females										
old	—	—	2	—	—	—	1	—	—	
adult	—	7	20	2	9	37	75	—	25	
young adult	1	—	2	—	1	3	6	—	—	
immature	—	—	1	1	1	2	53	—	3	
Total Females	1	7	25	3	11	42	87	0	28	204
Juveniles										
large	—	—	—	—	—	1	—	—	—	
medium	—	—	—	—	—	1	—	—	1	
small	—	—	—	—	—	1	1	—	2	
Total Juveniles	0	0	0	0	0	3	1	0	3	7
Adults, Sex Unknown	0	0	1	0	0	3	10	0	1	15
Total for Period	1	16	48	5	27	85	208	1	55	446

imens yield any information beyond age and sex. Butchering marks are found on two LPIII individuals from Room 42, on a specimen from Kiva C dating to MPIII and on one from Structure 8 dating to PII. A butchered specimen recovered from Room 46 is undated. Room 72 contained a PII specimen which has been scraped (perhaps in preparation for artifact manufacture), rather than butchered.

Bird bone artifacts are summarized in Table 54 by species, element, tool type and period. Turkey feathers, cordage and eggshell are covered in Table 55 and feather artifacts other than cordage may be found in Table 56. The latter category includes six rectrices, a terminal secondary and a primary covert shaped by the application of a coal; an erythristic rectrix shaped by cutting; a rectrix split as for fletching; the rachis of the rectrix of an immature bird, with erythristic down bound to the base with sinew; a rachis inserted in the stem end of a 6-row corn cob; a knotted rachis; two rachises sewed together with a string; the leading vanes of a right and left primary bound together with vegetal cordage, and miscellaneous feathers with pitch and red iron oxide on them, suggesting that they were decorated in this fashion or that they were used as paint brushes, or both.

Eggshell is in fresh, glossy, normally pigmented condition. Samples range in thickness from .275 mm to .425 mm, with a mean of .375 mm; this is rather thick shell, suggesting a healthy flock with adequate access to calcium.

Cranes

Sandhill cranes formerly were much more common in Arizona than they now are. The subspecies occurring at Antelope House, the lesser sandhill crane (*Grus canadensis canadensis*), probably was taken in the winter, as it breeds far to the north.

Grus c. canadensis: lesser sandhill crane (Minimum Faunal Count, 1 [3.03 percent of wild birds]; bird bone artifacts, 1 [4.35 percent]). The shafts of two left humeri were found. The crest of one had been ground off and it may have been intended for manufacture into a bone tube.

Doves

The mourning dove is a common summer resident in northern Arizona (Phillips, Marshall and Monson 1964: 42–43).

Zenaidura macroura: mourning dove (feathers, 3). Three tail feathers of the mourning dove were recovered from Antelope House.

Macaws

The most common parrots recovered from archeological sites in the Southwest are scarlet macaws. Both skeletal material and feathers of macaws have been recovered from Chacoan sites to the east and from Kiet Siel to the west, but feather artifacts are rare and bone artifacts are unknown.

Ara macao: scarlet macaw (feathers, 12; feather artifacts, 2 [4.26 percent]). Feathers consist of scattered contours. Feather artifacts include a corn cob fetish ornamented with contours and a textile strip decorated with contours. No long tail feathers, the common item of macaw feather trade, were found. The contours may have come from a live bird or from a skin traded in from an area where macaws were more abundant, such as Chaco Canyon or Wupatki, if not directly from Casas Grandes, Chihuahua, which appears to me to be the source of Southwestern macaws in this period (see Discussion below).

Owls

The screech owl, an insectivore, probably occurred in the open pinyon-juniper or in cottonwood stands in Canyon del Muerto. Great horned owls and pygmy owls are carnivores, the abundant great horned owl feeding mostly on rabbits and rodents. Pygmy owls feed on mice, small birds and lizards, as well as a few large insects. They are uncommon residents of coniferous forests in northeastern Arizona. Burrowing owls are grassland residents, inhabiting the burrows of such rodents as prairie dogs and eating large insects, small rodents and, upon occasion, birds (Phillips, Marshall and Monson 1964: 51–53).

Strigidae sp.: medium-sized owl (Minimum Faunal Count, 1 [3.03 percent of wild birds]). A right tarsometatarsus and the distal end of a tibiotarsus of an owl of the genus *Asio* or *Strix* remain unidentified.

Otus asio: screech owl (Minimum Faunal Count, 1 [3.03 percent of wild birds]). Screech owl is represented by seven cervical vertebrae.

Bubo virginianus: great horned owl (Minimum Faunal Count, 4 [12.12 percent of wild birds]; feathers, 13; feather artifacts, 1 [2.13 percent]).

Table 54. Bird bone artifacts, by element and period.

Element:		Radius	Ulna	Humerus		Tibiotarsus			Tarsometatarsus		
Artifact type:		Tube	Tube	Tube	Awl	Tube	Awl	Cut-off End	Cut-off End	Total	%
	Date										
Aquilo chrysaetos	Unknown		1							1	4.35
	Date										
Meleagris	Unknown		3		1	1	3		1	9	
gallopavo	LPIII	2	2			2				6	91.30
	MPIII		1				3	2		6	
Grus C.											
Canadensis	LPIII			1						1	4.35
		2	7	1	1	3	6	2	1	23	100.00%

Table 55. Turkey feathers, eggshell and feather cordage.

	PI	PII	PIII	EPIII	MPIII	LPIII	Navajo	Date Unknown	Total
Total Turkey Feathers	409	1,939	15	896	1,983	3,253	12	2,508	11,015
Erythristic	64	2		4	166	249	1	126	612
Silver Phase					4	22		8	34
Pied Mutation				1	6	1		4	12
Total Aberrant Coloration	64	2	0	5	176	272	1	138	658
Eggshell Samples	1	2	0	1	3	2	1		10
3-spun, S-wrapped									
Whole Feather Cord	20	30	0	30	29	154	1	80	344
Stripped Vane Cord		2		1				2	5
									349
Unfabricated Stripped Vanes	8	4	0	4	7	26	0	52	101

Table 56. Feather artifacts, other than cordage, by species and period.

Species	PI	PII	EPIII	MPIII	LPIII	Date Unknown	Total
Aves sp.	1					3	4
Accipiter cooperi					1		1
Buteo sp				2	3	1	6
Buteo jamaicensis					1		1
Meleagris gallapavo	2		1	4	9	6	22
Ara macao			1		1		2
Bubo virginianus					1		1
Colaptes auratus collaris					2		2
Passeriformes sp						1	1
Corvus sp					1		1
Corvus corax		1		1			2
Troglodytes aedon						1	1
Sialia mexicana	1	1				1	3
	4	2	2	7	18	14	47

Great horned owl specimens include a desiccated left foot and bones from one right and two left wings. Loose feathers are from the wings and body. The artifact is a complex of multiple tassels from the lower belly and leg coverts. The sample of unidentified eggshell may be great horned owl.

Glaucidium gnoma: pygmy owl (Minimum Faunal Count, 1 [3.03 percent of wild birds]). Two specimens, a cranium and part of a pelvis, were recovered.

Goatsuckers

Common nighthawks are common summer residents in the open Upper Sonoran Zone and above in northern Arizona (Phillips, Marshall and Monson 1964: 56).

Chordeiles minor: common nighthawk (Minimum Faunal Count, 1 [3.03 percent of wild birds]). An intact right ulna of an adult in the male size range was recovered, as was the case at Gran Quivira.

Woodpeckers

Both the red-shafted flicker and the yellow-bellied sapsucker still are present in the high mountains of Arizona during the nesting season and are more widely distributed at other times of the year (Phillips, Marshall and Monson 1964: 68–69, 72–73). All flickers are now considered conspecific; the varying colorations have been reduced to subspecific status.

Colaptes auratus collaris: red-shafted flicker (Minimum Faunal Count, 1 [3.03 percent of wild birds]; feathers, 12; feather artifacts, 2 [4.26 percent]). Red-shafted flicker remains include the head and left wing bones of a small adult in the female size range. Feathers include three primaries, three secondaries, two rectrices and four contours. The artifact is a left primary (ca. #7) tied to a string. Flicker remains are common in Anasazi area sites from Basketmaker II into the historic period. Heads of woodpeckers other than flickers sometimes are found, presumably because of their red "scalps."

Syhrapicus varius: yellow-bellied sapsucker (feathers, 2). A left primary (#6) and a left secondary are identifiable as yellow-bellied sapsucker.

Jays, Magpies and Ravens

These corvids often are recovered from Southwestern archeological sites, but not necessarily in areas conforming to their present distribution. Scrub jays and common ravens still are sufficiently widespread to occur in about the same areas they inhabited in prehistoric times, but magpies and white-necked ravens are not. Black-billed magpies, now found only in the San Juan River drainage in the northeastern corner of the state, as recently as 100 years ago penetrated as far southwest as the Little Colorado River (Phillips, Marshall and Monson 1964: 106).

White-necked ravens, on the other hand, are now found in southern New Mexico and southeastern Arizona grasslands. Bailey (1928: 490) believed the disappearance of the white-necked raven from its original, more northern range was associated with the extermination of the bison. As late as 1870, this raven ranged along the western edge of the plains as far as northern Colorado. By 1880 they were found only as far north as the Galisteo Basin. Then, as now, they were associated with a grassland ecology. The presence of this species at Antelope House would have been a surprise if the scaled quail, another grassland species, had not already been identified.

Common ravens are very large; white-necked ravens are markedly smaller; and crows are smaller yet. Their bones are easily distinguished. However, a white-necked raven in the field is difficult to tell from the other two species. White-necked ravens are used in the same ways as are common ravens and crows, when available. Indeed, remains of left wing fans of a common raven, a white-necked raven and a crow were recovered from the same provenience at Las Humanas. It appears that from 1100 on the aboriginal inhabitants of the Southwest included the white-necked raven in a class of "big black birds" utilized from Basketmaker II down to present-day pueblos, particularly where a Macaw Moiety is balanced by a Raven Moiety (SW Bird Lab Avian Crossfile).

Aphelocoma coerulescens: scrub jay (feathers, 14). Scrub jay feathers come from the wings, tail and breast.

Pica pica: black-billed magpie (Minimum Faunal Count, 1 [3.03 percent of wild birds]). An articulated mummy, partially feathered, lacks remiges and may have been brought to the pueblo for its flight feathers.

Corvus sp.: raven or crow (feathers, 4; feather artifacts, 1 [2.13 percent]). These fragments of feathers are too badly damaged to identify beyond the generic level. One specimen has been trimmed with heat.

Corvus corax: common raven (Minimum Faunal Count, 2 [6.06 percent of wild birds]; feathers, 11; feather artifacts, 2 [4.26 percent]). Common raven elements are a right and a left ulna and a right carpometacarpus. Feathers include primaries, secondaries and a rectrix. Artifacts include a leading vane of a left primary, which was stripped and tied to the stripped trailing vane, and various stripped and split primaries and secondaries.

Corvus cryptoleucus: white-necked raven (Minimum Faunal Count, 1 [3.03 percent of wild birds]). A fragmentary left humerus is identified as white-necked raven.

Wrens

One species was identified.

Troglodytes aedon: house wren (feather artifacts, 1 [2.13 percent]). The tails of three house wrens were made into a tripple tassel. These birds would have been taken as summer residents (Phillips, Marshall and Monson 1964: 117).

Thrashers

One species was identified.

Oreoscoptes montanus: sage thrasher (feathers, 1). Sage thrasher, another summer resident of the area (Phillips, Marshall and Monson 1964: 125), is identified from a right primary (#8). This species also was recovered from Badger House at Mesa Verde, Colorado.

Bluebirds

Western Bluebird, a common summer resident in the area today, also has been identified at Chevlon Ruin and at Grasshopper Pueblo (SW Bird Lab Avian Crossfile).

Sialia mexicana: western bluebird (feathers, 18; feather artifacts, 3 [6.38 percent]). Artifacts include a tassel made from the first four right primaries, the first five right secondaries and a covert; a double tassel made from eight rectrices, and the skin of a head and neck with beak attached, wrapped with cordage. Loose feathers include specimens from the wings, tail and body, and a patch of feathered skin from blue-plumaged adults. The colorful adults apparently were selected over brownish immatures.

Blackbirds

Brewer's blackbird often accompanies the corvids in archeological sites. Although it is an icterid, its glossy black feathers apparently were considered desirable, just as were those of ravens, crows and magpies.

Euphagus cyanocephalus: Brewer's blackbird (feathers, 4 [.03 percent]). Feathers include rectrices and secondaries.

Towhees

Cholura cholura: green-tailed towhee (feathers, 2 [.02 percent]). Both green-tailed towhee feathers are rectrices.

Discussion

Turkeys.

Turkeys compose the vast majority of the collection in all categories, contributing 93.12 percent of the Minimum Faunal Count, 91.30 percent of the bird bone artifacts, 100 percent of the feather cordage, 46.81 percent of the feather artifacts other than cordage, 90.91 percent of the eggshell and 11,015 feathers. Males, females and juveniles are represented in both feather and bone samples, although adults, particularly those three years old or older, predominate. Eggshell and a few small, medium and large juveniles indicate that turkeys were raised by the residents of Antelope House.

The history of turkey culture in Canyon del Muerto is a long one. Ann Morris (1941) vividly describes the large numbers of desiccated turkeys found buried in caves utilized by the Basketmaker people of the area. These turkeys were domesticated early for use in the production of feathers, which were wound on vegetal cordage and twined into lightweight, but extremely warm, feather-cord robes.

The use of turkeys for food began much later; while it appears to have been as early in Canyon del Muerto as it was at Mesa Verde (that is, Pueblo II or approximately the late 900's), it does not seem to have been as extensive. Archeological evidence indicates that artifact use of turkey bone follows food use. In sites where wild or domestic turkeys were eaten, small artifact forms, such as fine awls formerly made from fox and jackrabbit bone, tend to be made from turkey bones instead. The low frequency of turkey bone artifacts at Antelope House is startling, consid-

ering the size of the collection. It is a much smaller aggregation than one would expect from a contemporaneous site at Mesa Verde, for example. Both the scarcity of turkey bone with butchering marks and the low frequency of turkey bone artifacts, particularly in the Pueblo III sample, tend to substantiate the hypothesis that Antelope House turkeys were more important as a source of feathers than as a source of meat.

Turkey consumption in some sites appears to be related to fat requirements. A corn-based diet, even when supplemented with beans, requires fat from some source to assuage hunger. In some sites, such as Grasshopper Pueblo, wild turkeys were hunted at their fattest, when the gobblers were just going to the strutting grounds; pregnant does also were taken at their fattest. This pattern does not seem to apply at Antelope House, perhaps because another source of fat, such as cottonseed, was readily available.

If 8 pounds of usable meat is allowed for a female turkey and 12 pounds for a male, the following quantities of meat could have been provided by the turkeys represented by bones recovered from the site:

Period	Pounds of Available Meat
Basketmaker III	8
Pueblo I	164
Pueblo II	464
Pueblo III	48
Early Pueblo III	280
Middle Pueblo III	780
Late Pueblo III	2,016
Total Pueblo III:	3,124
Navajo	12
Time Unknown	500

Although 4,272 pounds of meat would have been available, it is likely that few turkeys actually were eaten, since the emphasis of turkey culture at this site appears to have been on feather production.

The normal color of adult Indian domestic turkey legs is dragon's blood red, but yearling turkeys have exanthine orange legs, as do yearling specimens of Merriam's wild turkeys. Five desiccated turkey legs discarded in Antelope House trash are exanthine orange, suggesting that the few turkeys eaten were in the yearling age range.

Few specimens of bone are cut; more are burned, suggesting that the bones may have been cast into the fire after the meat was consumed.

The presence of a majority of adult turkeys 3 years old and older is consistent with an emphasis on turkey culture for feather production. An interesting gap in the collection is the extreme rarity of the shaggy feather cord made from the stripped vanes of flight feathers. Loose feathers indicate that the inhabitants of Antelope House had honed feather production to such a fine art that rectrices and secondaries were allowed to grow only to the size suitable for wrapping cordage before being plucked and used. This must have resulted in a rather moth-eaten appearing turkey flock, as substantiated by the natural mummies I have examined. In view of the extensive stripping of rectrices and secondaries, the question is: What happened to the cordage made from these strips? One possibility is that it was traded to pueblos where turkeys were not so numerous.

Of particular interest in the study of turkey feathers from dry cave sites has been the prevalence of aberrant coloration. Specimens from Antelope House include three types of partial albinism: erythrism, a red phase; pied mutation, a white-splotched phase; and silver phase, a black-tipped white phase. While erythristic and pied mutation have been identified from other sites, silver phase is thus far known only from Antelope House (Table 57).

The distribution in time and space of turkey feathers of aberrant coloration (Table 58) was examined in order to determine whether it followed the distribution of live turkeys, as indicated by distribution of dung, eggshells and relatively whole carcasses. Erythristic feathers were recovered only in the North Room Block in Pueblo I proveniences, switching to the South Room Block in Pueblo II and remaining prodominant there until late Pueblo III, when they were more widely distributed, particularly in the Central Plaza area.

Kelley (1975: 83, 84) points out that turkeys were no longer limited to the South Plaza after about AD 1150, but proveniences of feathers of aberrant coloration were not really widely distributed or predominantly present in the Central Room Block until after AD 1200. Perhaps the distribution of feathers of aberrant coloration

Table 57. Recovery of aberrant turkey feathers from selected Southwestern sites.

Period	*Erythristic*	*Pied Mutation*	*Silver Phase*
Basketmaker III		Step House	
		Sand Dune Dave	
Pueblo I	Antelope House		
Pueblo II	Antelope House		
	Tularosa Cave		
Pueblo III	Antelope House	Antelope House	Antelope House
	Canyon de Chelly	Step House	
	Step House	Long House	
	Long House	Mug House	
	Kiet Siel		
	Inscription House		
	Bc 288, Chaco Canyon		
	Gila Cliff Dwellings		

Table 58. Distribution in time and space of aberrant colorations in turkey feathers from Antelope House.

	South Room Block				*Central Room Block*				*North Room Block*			
	Eryth.	*Pied*	*Silver*	*Total*	*Eryth.*	*Pied*	*Silver*	*Total*	*Eryth.*	*Pied*	*Silver*	*Total*
LPIII	11	0	3	14	20	1	7	28	15	0	2	17
MPIII	12	4	3	19	3	0	0	3	0	0	0	0
EPIII	5	1	1	7	1	0	0	1	0	0	0	0
PII	1	0	0	1	0	0	0	0	0	0	0	0
PI	0	0	0	0	0	0	0	0	2	0	0	2
Area Totals				21				32				19

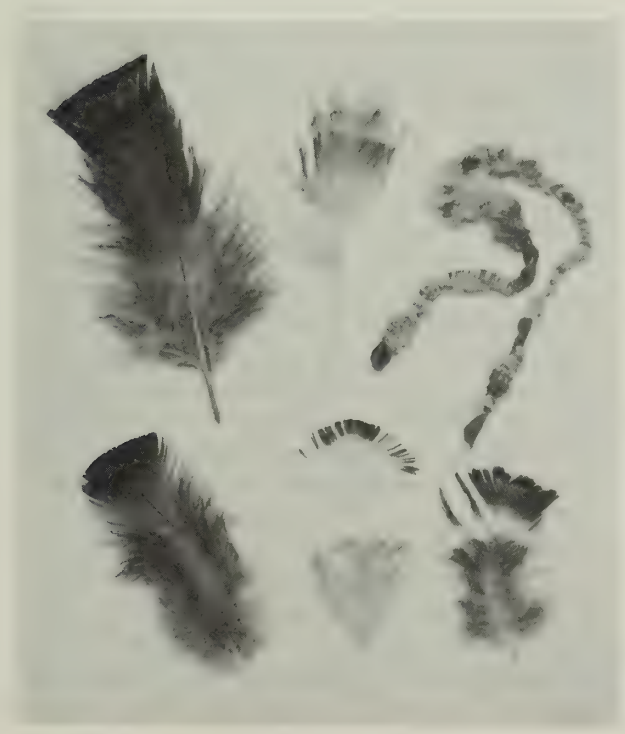


Figure 52. Lighter, aberrant color phases from Antelope House turkeys contrast with darker, normal coloration of modern feathers at left. Aberrant phases are seen in erythristic upper tail covert (top center), 2-ply S-spun Z-twist cordage S-wrapped with erythristic feathers (top right), silver phase contour (center), erythristic contour (bottom center), and pied contour.

should be related to cultural factors, rather than to areas inhabited by live turkeys.

Melanism, albinism and silver phases still occur among wild turkeys (Hewitt 1967: 30, 35, 43, 53). All aberrant color phases so far encountered among archeological feathers are types of partial albinism. Van Tyne and Berger (1959: 99) list erythrism as rare, except in another gallinaceous bird, the prairie chicken. The least bittern is subject to an erythristic phase and an erythristic mallard is illustrated in color by Kortwright (1953: Plate 36H). Aberrant plumages from Antelope House are illustrated in Fig. 52.

Although the turkey generally is thought of as a black bird with brown markings, the basic color is white, a schemochrome or structural color. Over this, a wash of reddish-brown melanin is deposited in appropriate areas, such as the rectrices. Patterning of black melanin is formed independently. In erythristic fowl, the black melanin is not deposited, although alteration of the feather structure in the areas where it normally would be present gives a pale grayish cast. The result is a turkey with a pale gray body, white gray-barred wings and a rufous tail tipped with gray and cream.

The pied mutation results in birds in which the primaries and secondaries are glossy white with a few black splotches. Body feathers are splotched with white and rectrices are banded with white.

Silver phase turkeys are described in detail by Williams (1964: 148–152), who believes this aberration to be the result of the absence of metallic brown and nonmetallic buffy brown. Since the metallic irridescence apparently is structural in nature, the missing pigment is that observable in unmixed form on the cream-buff tips of normal rectrices. The resulting bird is smoke-gray to white, with black-tipped contours, pale secondaries and pale, white-tipped rump and tail feathers.

Although the bill and feet of erythristic turkeys are unpigmented, those of pied mutation and silver phase turkeys apparently are normally colored.

The frequency of the erythristic color phase seems higher than might reasonably be expected from comparison with samples from other sites. Erythrism is a rare mutation, and no mention of erythristic turkeys was found in the literature. The literature search for examples of partial ablinism among wild turkeys, however, revealed that Williams (1964: 148–152) had observed silver phase wild turkeys. Pale mutants per flocks in which they were observed totaled 8:252, or 3.3 percent; pale mutants against all turkeys he had ever seen total 8:4000, or .2 percent. While the pied mutation and silver phase percentages from Antelope House agree fairly well with these sightings among wild birds, the percentage for erythristic birds is considerably higher. As a further check on the validity of the statistical analysis, Dr. Christy G. Turner II suggested that hunters be sought who knew the locations of wild turkey flocks containing erythristic individuals, so that by examining feathers under roosting trees, we might learn whether there is differential shedding between erythristic and normally colored individuals. I found one hunter, Doyle Poor, Jr., who had observed pale individuals with feathers like those from Antelope House during the hunting seasons of 1968 through 1973. He reports that if there is any difference at all in feather loss between erythristic and normally pigmented turkeys, he believes that the erythristic turkeys may lose fewer in proportion to their numbers. Erythristic turkeys were not observed by Poor during the 1974 through 1976 hunting seasons.

It is known that turkeys with unusual colorations were raised deliberately in Mexico in pre-Colombian times, so that it is not surprising that these colorations are found in Southwestern sites. Antelope House produced three specimens of off-white feather cordage from erythristic turkeys, a specimen of brown feather cord ornamented with a small erythristic feather pendant and a feather with erythristic down fastened to the base with sinew, similar to a paho.

While it cannot be said that the large number of erythristic occurrences at Antelope House prove that man was selecting these specimens for breeding because of their unusual coloration, chi-square testing indicates that it is extremely unlikely that such unusual numbers are the results of sampling error, particularly in such a large collection representing such a long span of time.

The domestic breeds raised in the Southwest are derived from different subspecies than are the domestic turkeys found in the Valley of Mexico, but the same mutations occur again and again, with more or less predictable regularity, in the various subspecies. There is no reason to believe that if flocks of specially colored turkeys were kept in Mexico (Dibble and Anderson 1963: 53), the Indians of the Southwest, who might have received the feathers of these birds as high-priced trade items, would not have taken advantage of the identical mutation if it occurred in their own stock.

Brown-toned turkey feathers are present throughout the Antelope House collection. These have brown rachises and secondaries with a beautiful green irridescence, as do those in the collection recovered from excavations at Sand

Table 59. Measurements of Antelope House turkeys.

Large Indian Domestic			
Male	*Specimens*	*Females*	*Specimens*
Humerus 140.2–146.05 (143.28)	4	114.7–121.4 (117.50)	3
Tibiotarsus		178.5–185.2 (181.85)	2
Tarsometatarsus 158.0–158.5 (158.16)	3	120.2–126.3 (122.25)	2
Small Indian Domestic			
Humerus		112.5	1

Dune Cave (Hargrave 1970: 25) and in specimens from Step House. The latter collections include only a few feathers and interpretation of their significance was not possible until the large collection of well-preserved feather specimens from Antelope House became available for comparison. Because it is now apparent that the brown-toned feathers are from the large juvenile stage of Indian domestic turkeys, they have not been included in the discussion of aberrant colorations.

Antelope House turkey feathers show some fault lines, indicative of temporary stress, but to a lesser degree than in specimens from many other sites. Bone pathology is present in the form of healed fractures, rather than in the extreme rachatic warping found in some sites. The birds apparently were well cared for, were well fed, were allowed sufficient access to sunlight for sustained good health and lived long lives, even if crippled by accidental fractures.

The main body of turkey bone is from the large Indian domestic breed, the domesticated form of Merriam's wild turkey (*Meleagris gallopavo merriami*). It is the dominant breed at Canyon de Chelly, Canyon del Muerto, Glen Canyon and Mesa Verde from the 600's and was diffused to major centers of population in the Southwest during Pueblo II (SW Bird Lab Avian Crossfile). Although the evidence is fragmentary, Antelope House turkeys are large (Table 59) and conform both in character and proportion to the classic type found at Tse-ta'a, a Basketmaker III through Pueblo III site in Canyon de Chelly.

Three specimens, however, are small Indian domestics, a breed domesticated from the recently extinct tularosa turkey (*Meleagris gallopavo tularosa*) (Schorger 1961: 138–144; 1970: 168–170). A desiccated specimen of this species from a Basketmaker II site in Canyon de Chelly is estimated by the National Park Service to date from about AD 250, although the dating of the specimen is questionable. The specimen was decapitated and had a strand of vegetal cordage about its neck. There is no longer any reason to believe that this specimen was not domesticated. If the assigned date is correct, the small Indian domestic breed was kept by Canyon de Chelly and Canyon del Muerto Indians almost 400 years earlier than was the more numerous large Indian domestic breed. Although in the minority, the small Indian domestic breed was found in such widely separated areas as Mesa Verde, Colorado, and Casas Grandes, Chihuahua, during Classic Pueblo occupations. It was present at Tularosa Cave before 1100 and was the specialty of the Tompiro Pueblos in New Mexico from the late 1200's until the fall of Las Humanas in 1672, when it disappears (SW Bird Lab Avian Crossfile).

That the Tompiro turkeys were all small Indian domestics and that sites to the north and south have small samples of this breed suggest that the Tompiros were the source of supply for these birds. Unfortunately, there is no archeological evidence of large herds of small Indian domestics before 1275.

By contrast, the large Indian domestic is known in Glen Canyon, Canyon de Chelly, Canyon del Muerto and Mesa Verde in the 600's. Between AD 900 and 1100, the breed spread as far west as the Grand Falls of the Little Colorado River, as far east as Ranchos de Taos and along the western border of New Mexico as far south as Casas Grandes, Chihuahua. It remained the dominant form in the Southwest until 1723, when the last turkey herds are recorded (Schroeder 1968: 103).

Finally, it is always interesting to determine how and where in a site turkeys were kept. South Room Block specimens of the small Indian domestic turkey come from Room 21 in Pueblo II and Middle Pueblo III levels, indicating that

the turkeys were kept in the same area, perhaps by the same family, over a long period. Another Middle Pueblo III sample was recovered from Kiva C. The Late Pueblo III specimens are from Room 5 in the northern section of the pueblo. Eggshells were concentrated in Room 21, which also contained major elements of three headless individuals. Room 21 may have been inhabited by turkeys after its abandonment by humans or it may just be a repository for refuse. Structure 8, however, seems to have been a turkey enclosure. Here were found the articulated major elements of two adult female and one adult male large Indian domestics. Layers of turkey feces were found in the South Plaza, Central Plaza, Central Plaza Annex, the Corridor and, to a lesser extent, in the North Room Block.

Macaws.

No macaw bones were submitted for identification, but several samples of macaw feathers were. Forty-seven small red contours had been fingerwoven into a cotton band, which must originally have been longer. Only the bases of the feathers remain, so that we have no clear picture of the original beauty of the band. Probably equally handsome was a corn ear fetish bound with red, yellow and, perhaps, blue scarlet macaw feathers. Only the black base of macaw contours is present, which undoubtedly graded to blue at the tip. Scarlet macaws are predominantly red, but they also produce yellow and blue feathers. Red is the color commonly identified from archeological sites, yellow is rare and I do not recall having seen blue contours anywhere but in the Antelope House collection. Scarlet macaw contour feathers found scattered through the site are red, with the exception of four tiny fragments found in a cache.

The earliest macaws from the Southwest which I have examined came from Snaketown. They may be referred to the Estrella phase, but are probably no earlier than AD 40. These birds do not appear in the Southwest again until the Perros Bravos phase (950–1060) at CHIH D:9:2 near Casas Grandes. Only one specimen was recovered and it most likely is late in the period. It is interesting that Room 30 at this site, which produced the carbon end-date for the period, also had on the floor six sherds of Mimbres Classic Black-on-white. To the north, in the Mimbres Valley, we have a scarlet macaw at Cameron Creek Village, dating between 1000 and 1150, as well as a military macaw and three scarlet macaws, dating between 1100 and 1150 (DiPeso 1974: Vol. 4, p. 30 and Vol. 8, p. 276; Hargrave 1970b: 48).

If we accept DiPeso's dates of 1060 to 1205 for the Buena Fe phase at Casas Grandes proper, we have a source in the south for the earliest macaw remains at Pueblo Bonito in Chaco Canyon and at Antelope House, both of which date just prior to 1100 (Hargrave 1970b: 32). Scarlet macaw feathers from Chetro Ketl may well be contemporaneous (SW Bird Lab Avian Crossfile).

Of the 675 macaws I have examined during the last 12 years, 504 came from Casas Grandes. This leads me to regard Casas Grandes as a major source of supply for macaws found at sites north of the international border. In addition, of the macaws datable to a single phase, macaws peak in the same manner both at Casas Grandes and in the remainder of the Southwest (cf. DiPeso 1974: Vol. 8, p. 185).

The view presently held by some archeologists that Casas Grandes was probably not a major trading center before 1300 totally ignores the fact that of 166 macaws from Arizona and New Mexico, dating between 100 BC and AD 1672, 106 occur between AD 1080 and 1200. Only 41 occur in sites occupied at AD 1300.

This dispute reminds me of the argument about who wrote the *Iliad*. The conclusion was that if it wasn't Homer, it was someone else by the same name. The fact that macaws or their feathers are present at both Pueblo Bonito and Antelope House prior to 1100 is indisputable. The fact that a macaw specimen found at CHIH D:9:2 dates to the Perros Bravos phase is indisputable. If some do not wish to accept the Casas Grandes area as an avenue for trade at a time when these sites and the Mimbres sites were being supplied with macaws, they are faced with the necessity of looking for another trading center just like Casas Grandes. They are also faced with explaining why the Galaz site and Casas Grandes are the only sites at which military macaws are known to occur.

During Middle Pueblo III (1205–1261), there was a drastic drop in the number of macaws (five) at Casas Grandes, Chihuahua (DiPeso 1974: Vol. 8, pp. 283–284), and a corresponding drop in the Southwest. From 1251 to 1340, macaws again became more numerous (28), but totaled

Table 60. Wild and captive avifauna from Antelope House and four nearby areas.

Antelope House	*Mesa Verde NM*	*Chaco Canyon NM*	*Wupatki NM*	*Sand Dune Cave*
Mallard	x	x	x	x
Gadwall				
Green-winged Teal				
American Widgeon		x		
Shoveler				
Bufflehead				
Turkey Vulture	x		x	x
Cooper's Hawk	x		x	
Red-tailed Hawk	x	x		x
Swainson's Hawk	x	x		x
Golden Eagle	x	x	x	x
Peregrine Falcon				
Sparrow Hawk	x	x	x	x
Scaled Quail		x	x	
Lesser Sandhill Crane		x	x	
Mourning Dove	x	x		x
Scarlet Macaw		x	x	
Screech Owl	x	x	x	
Great Horned Owl	x	x	x	x
Pygmy Owl				
Burrowing Owl			x	
Common Nighthawk				
Red-shafted Flicker	x	x		x
Yellow-bellied Sapsucker				x
Scrub Jay	x			x
Black-billed Magpie	x	x		
Common Raven	x	x	x	x
White-necked Raven				
House Wren				
Sage Thrasher				
Western Bluebird				
Brewer's Blackbird	x			
Greentailed Towhee				
	15	15	12	12

less than 40 percent of the AD 1100–1150 high. None of the feathers at Antelope House can be assigned to this last peak in trade.

Wild Birds.

The Antelope House collection includes the remains of 34 species or subspecies of wild or captive birds, in addition to two breeds of domestic turkeys. An average site in the Southwest will produce an avian list of about 35 species. Table 60 compares Antelope House avifauna with that identified from Mesa Verde National Park to the northeast, Chaco Canyon National Monument to the southeast, Wupatki National Monument to the southwest and Sand Dune Cave, a single site to the northwest. None of the species identified are peculiar to Antelope House.

The finest specimens of wild bird feather artifacts are labeled "Earl Morris Backdirt." If our best specimens weren't even worth picking up, I cannot help wondering how much really important material was removed before this excavation. Some of the apparent inconsistencies in the Antelope House collection and its interpretation undoubtedly would be remedied if all available pieces of the puzzle had been left in place.

Implications for Environmental Change

The avian list indicates that certain changes have taken place in the environment of the Antelope House area during the last 700 years. The presence of scaled quail, burrowing owl and

Table 61. Dated water forms.

Species	*PI*	*PII*	*PIII*	*EPIII*	*MPIII*	*LPIII*
Dated Water Forms From Feathers:						
Anatinae sp	1	1		1	4	3
Anas p. platyrhynchos						2
Anas strepera					1	
Spatula clypeata						1
Euphagus cyanocephalus	1					4
Total Water Forms	2	1	0	1	5	10
Total Water Birds	9	3	0	13	10	66
% of Wild Birds	22.22	33.33	.00	7.69	50.00	15.15
% of Total Feathers	.48	.05	.00	.11	.26	.30
Dated Water Forms From Bones (MFC):						
Anas platyrhynchos						4
Anas carolinensis	1					
Bucephala albeola						1
Falco peregrinus			1	1		
Total Water Forms	1	0	1	1	0	5
Total Wild Birds	2	3	1	1	2	10
% of Wild Birds	50.00	.00	100.00	100.00	.00	50.00
% of Total Birds	.02	.00	.02	.02	.00	.10

white-necked raven suggest that the area formerly was covered with a good stand of grass or that such a stand was available fairly close by.

Dabbling ducks prefer pools of rather shallow standing water, rather than the intermittent rapid runoff one now associates with the area. Blackbirds also prefer the seeps and springs characteristic of an area with sufficient vegetation to hold rainwater for subsequent slow release.

Given that the surroundings of Antelope House have changed, one might ask whether the change is the result of denuding of the landscape by earlier inhabitants of the canyon or whether it is a fairly recent phenomenon related to overgrazing.

Table 61, which summarizes the archeological occurrence of water forms, was compiled in an attempt to answer this question. The results are inconclusive; avian remains repeatedly have proved to be indicators of socio-politico-religious trends and/or of trade contacts, rather than environmental indicators. Man consistently has obtained the birds he preferred for his various purposes, regardless of the inconvenience involved. Large mammals are better indicators than are birds of dietary composition, and small mammals, such as kangaroo rats, mice and shrews, are the best indicators of environmental change, as they are very sensitive to environmental variables.

Summary and Conclusions

It may be said that the Anasazi of Antelope House depended heavily on domesticated turkeys for meat, clothing and tools, but it would be incorrect to think of the inhabitants of Canyons del Muerto and de Chelly as being dependent upon turkeys in the same way as were the people of Mesa Verde and the later upper Rio Grande pueblos.

Turkeys were kept very early in the Antelope House area, probably at least 400 years earlier than at Mesa Verde, and they were kept in substantial numbers for a period of 1000 years. Food and artifact use began as early as Pueblo II (sometime after AD 950) both at Antelope House and at Mesa Verde, but the emphasis at Antelope House remained on feather production even after food use began. Nowhere else do we have evidence of such attention to feather production, nor are turkey feathers present in such a wide variety of colors or in such high proportions of aberrant coloration elsewhere. Nowhere else do we have so much evidence of stripped-vane cordage manufacture with so little of it present. These factors strongly suggest that Antelope House was the site of specialization in production of feather-cord robes for trade.

Chapter 13

The Nonavian Faunal Remains

This discussion of the nonavian faunal remains is based on data provided by Stanley J. Olsen. Working under his direction were James Kelley, John Sparling, Victoria Dirst and Nancy Hamblin. Many of the interpretations of this material are not their responsibility. John Sparling wrote the section on bone artifacts and their manufacture, while James Kelley and John Sparling co-authored a short discussion of the canids. Additional analyses were performed by the Antelope House staff.

The data provided by Olsen's workers indicates that the artiodactyls, particularly pronghorn and mule deer, provided the bulk of hunted animal food at the site. Appendix H lists in taxonomic order all nonavian fauna identified from Antelope House, by period.

Distribution of Important Species

When the canyon was uninhabited, its water and vegetation probably attracted large numbers of animals. Due to intensive occupation and use of the Canyon de Chelly area by the Navajo, the modern fauna of the region is impoverished, particularly in the lower and middle canyon bottom areas (Burgess 1973; Eaton *et al.* 1937). It is not unreasonable to assume that by Pueblo III times the same general situation prevailed; the larger food animals would be unable to sustain populations within the canyon, but would be dispersed on the plateau and lightly inhabited areas nearby. During seasons when water was scarce and succulent crops were available, it is probable that deer and rabbits were attracted to the canyon floor, where the vigilant Anasazi, aided by the numerous trap-like rincons and escarpments, quickly added to their larder, much as the Hopi do today. Most of the mule deer at the site must have been taken outside the canyon. Based on food preferences and modern habitats, we can establish the following general model for prehistoric game distribution:

1. Mule deer, primarily browsers (Eden 1937: 36), would feed on shrubs and oaks of the Talus Communities and Rims, Cliffs and Ledges. They would be expected to migrate from winter range to summer range (Seton 1929: 36), when they would herd together, and to prefer ridges near the rim of the plateau, which would be sheltered from prevailing southwest winds and where foods would be readily accessible (Miller 1970).

2. Pronghorn prefer the open plains and open pinyon-juniper forest (Knipel 1944: 8; Eaton 1937: 37), where they would eat cactus and sage (Seton 1929: 447). They would bed in pinyon-juniper during the winter, when they would be especially vulnerable to hunters (Seton 1929: 419). Winter range is characteristically below 6600 ft. (Knipel 1944). They are usually found in herds.

3. Cottontail of one species or another (*Syl-*

vilagus auduboni, S. nuttali) would be found throughout the area, where they would consume most vegetal foods, unless kept from doing so by human hunters. Cottaintails should flourish in the canyon bottom, although *S. nuttali* also is found at higher elevations (Cockrum 1960).

4. Jackrabbits (*Lepus californicus*) generally are found in dry plains environments up to the Transition Zone (Seton 1929: 746; Eaton 1937: 35). They should not be prominent in canyon bottom fauna.

5. Bighorn (*Ovis canadensis*) are notably intolerant of man (Moser 1962). They need a variety of plants (Eaton 1937: 38), including grasses and willows (Moser 1962). They probably were not prominent in local fauna by PIII times, if their declining importance at Mesa Verde from PII to PIII (Hayes 1975: 185) is reflected at de Chelly. Good climbers (Eaton 1937: 38), they would be the common large artiodactyl in the canyon when it was uninhabited by man.

Thus we would anticipate finding mule deer on the higher plateaus, concentrating where browse is available (the vegetation of the canyon would have been attractive were it not for human population). Antelope would be found in the open valley and up into the lower fringes of the pinyon-juniper forest. Jackrabbits would be found throughout the open portions of the plateau, while cottontails, which are more wide-ranging than most other species, would occur primarily in the canyon bottom. The rare bighorn would center on the canyon. Bear and other carnivores would range throughout the area. It is debatable whether bear and bighorn were consumed at Antelope House; if so, they must have constituted a sporadic source of meat. It would appear that of the prominent game animals, only cottontail, bighorn and, to a lesser extent, deer would occur close to the site. Most of the deer lived on the plateau and in the Chuska Mountains, while antelope concentrated on the lower plateau and the Chinle Valley, an area in which jackrabbits would also be plentiful.

Given this hypothetical array of food resources, how were they harvested? Several techniques, both communal and individual, are known from Southwestern ethnographic literature. Hunting is almost exclusively a male pursuit and is invested with ritual significance. Several techniques of killing are noted, including use of the bow and arrow and chasing an animal to exhaustion and smothering it (Cushing 1883; Titiev 1944). Game drives using corrals and wing walls are reported for the Hopi (Titiev 1944).

Trends Through Time

As noted in previous chapters, the various periods were differentially sampled in the excavation of Antelope House. Therefore, to allow meaningful discussion of temporal trends, the adjustment factors developed in Chapter 10 were applied to the raw faunal data.

There is a trend in bone frequency parallel to that observed for vegetal material: a pronounced dip in MPIII times, with rebound noted in LPIII. While deer, jackrabbits, cottontails and other species rebound, antelope remains low, suggesting either their relative absence after

Figure 53. Stone and wood projectile points through time (adjusted for provenience number).

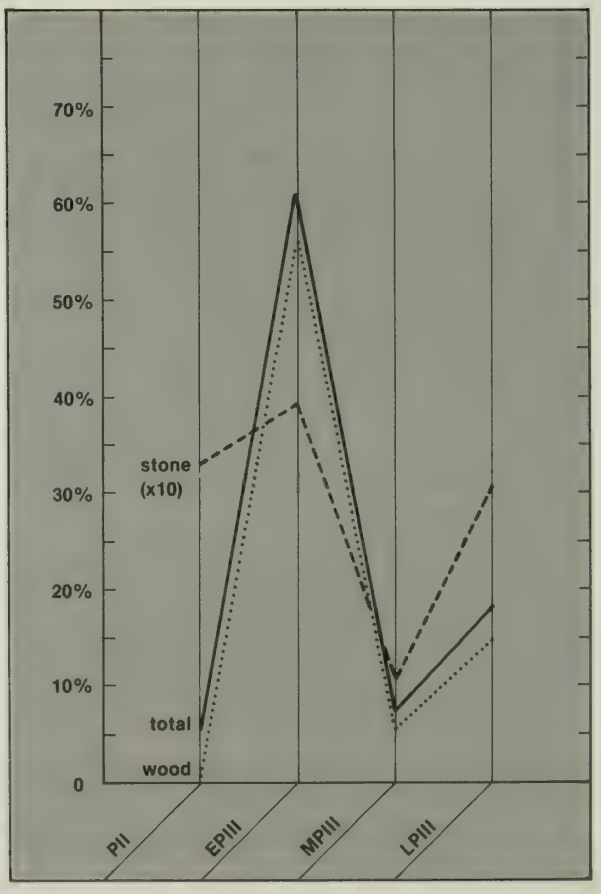


Table 62. Species and types of projectile points recovered, by period.

Species	Volume adjusted by PII (12.2)		Volume adjusted by EPIII (5.16)		Volume adjusted by MPIII (30.99)		Volume adjusted by LPIII (36.56)	
	No.	MNI	No.	MNI	No.	MNI	No.	MNI
Lepus	4.09	.49	7.75	1.16	2.00	.26	8.86	.52
Odocoileus	4.91	.49	17.05	.58	7.94	.29	15.48	.33
Sylvilagus	4.75	.73	8.52	.58	2.39	.32	16.19	1.67
Antilocapra	1.22	.16	1.94	.58	0.23	.06	0.65	0.14
Lynx	.41	.08		.19				
Cit								
O. canadensis			0.19(1)	(1).19	0.16(2)	.06	0.27(10)	.05
Peromyscus			.58	.97	.10	.10	.79	1.01
Neotoma	.16	.16	.39	.19	.29	.19	2.30	.68*
Cynomys	.33	.16	.58	.39	.16	.10	.98	.35
All projectile points	.57		6.01		.65		1.75	
Wood projectile points	.08		5.62		.55		1.45	
Stone projectile points	.33 × 10	3.3	.39 × 10	3.9	.10 × 10	1.0	.30	3.0

* looks like late intrusion

MPIII or a shift in hunting practices. Does the distribution of hunting implements parallel this general trend? If so, it would suggest that the effort expended in hunting activities was adjusted to the availability of game. If more hunting implements were produced and less game resulted, the inference would be that increased effort, with lower returns, was devoted to hunting. The most suitable hunting implement for this analysis is the projectile point; its occurrence is adjusted for provenience by the same procedure used for determining animal and plant species trends for PII through Late PIII times. The results, plotted in Figure 53, show a generally similar curve, except for an upsurge in frequency in Early PIII proveniences. Whatever precipitated this increase affected the wooden points (Table 62), which became popular at this time; a plot for stone points shows less of an upcurve in Early PIII than is the case for wooden points. Perhaps the wooden points were useful in warfare; this hypothesis for their increase in Early PIII times, however, is not corroborated.

Archeological Comparison with Behavioral Chain

Evidence for use of the bow and arrow is abundant. In addition to several bow fragments, 106 wooden points and 28 chipped stone points are distributed as follows:

	Wood	Stone	Total
PI	4	8	12
PII	3	4	7
EPIII	29	2	31
MPIII	17	3	20
LPIII	53	11	64
	106	28	134

The shift from stone to wood in PIII times is shown by chi-square to be significant at a probability of .005. Although differential preservation may be involved in this distribution, the relatively small number of stone points recovered from more voluminous PIII proveniences suggests a real trend, the reason for which is not obvious. Raw material for points is abundant in the area today, so this is not a likely cause (see Chapter 27). The wooden point would appear to be an efficient penetrator, although it would lack the weight of a stone point, a significant factor in stabilizing the arrow in flight. On the other hand, a wooden point would be less likely to shatter when glancing off a rock than would a stone point. The typical bow shot in the pinyon-juniper woodland would be rather short and a less accurate arrow might not be a great disadvantage. As for use in hunting the plains-dwelling antelope, where a long shot might be more common, note that antelope and stone points both show a decrease in PIII times at Antelope

House. It would be worthwhile to test this correlation at sites where antelope might be more common, to see if this correlation would hold.

Since the residents of Antelope House were indifferent knappers, at best, it may be that the production of wooden points was easier. Although considerable abrading and smoothing is involved in producing a wooden point, the process requires less skill and training that does chipping.

In any event, our data point to the use of wood-tipped arrows in Late PIII times, when mule deer and bear (including a possible grizzly, *Ursus horibilis*) were successfully hunted. No shift in species hunted can be correlated with the change from stone to wood, other than that noted above.

Comparisons with Other Sites

The only reported faunal analysis from Canyon de Chelly is Thomas Mathew's Tse-ta's study (Steen 1966). Although his is a much smaller collection (159 bones studied), there is little doubt that both collections represent essentially the same fauna. The greater number of species at Antelope House is expectable, given the different sample sizes. The sites are similar in the large numbers of turkeys present. The more numerous animals are listed below (the numbers given are the MNI's for each site as a whole):

Tse-ta'a	**Antelope House**
cottontail—10	cottontail—94
jackrabbit—26	jackrabbit—49
mule deer—21	mule deer—40
pronghorn—5	pronghorn—16
	mouse (*Peromyscus*)—47
	pack rat (*Neotoma*)—40
	prairie dog—24

The ratio of jackrabbit to cottontail is reversed at the two sites, which probably is due to differing archeological techniques and sample sizes. Elk (*Cervus* sp.) is recorded at Tse-ta's (Steen 1966: 150), but not at Antelope House.

Of the new identifications from Antelope House, perhaps the most surprising is muskrat (*Ondatra zibethecus*). This animal is not presently part of the local fauna and within Arizona is restricted to the Salt River drainage and the White Mountains (Cockrum 1960: 211). As noted above, its presence in de Chelly suggests wetter conditions and clear water.

The flannelmouth sucker (*Castostomus latipinnis*) from the site is somewhat unusual for a Southwestern site, although it is not particularly surprising in this situation. A related species is present in upper del Muerto (Burgess 1973). During periods of high water today, stranded fish, typically rainbow trout from man-made Tsaile Lake, can be caught from streamside. The project staff encountered fresh skeletons on high ledges in the canyon, where they were carried by raptorial birds; the discovery of such remains at Antelope House does not prove they were part of the cultural system of the site or that they were an item in the diet.

Butchering

Butchering practices have not been explicitly described for Western Pueblo groups, although discussions of game division (Titiev 1944) have used the term quartering in a very general sense.

Butchering marks were observed by Olsen's workers on artiodactyls, particularly mule deer. In general, incisions on the bone elements are confined to the limbs, skull and vertebrae. Only one rib was observed to possess a butchering mark, a drastic change from most archeological faunal assemblages, where ribs are commonly incised (I am indebted to Richard S. White for this observation). Flint knives and utilized flakes were employed in butchering. Since all parts of the skeleton are represented for mule deer, it seems likely that some of the animals were carried to the site more or less intact. Our model of mule deer distribution suggests that while most deer were killed on the plateau, a few would have been taken in the canyon close to Antelope House. Accordingly, all major elements of the skeletons of animals killed very close to the site should be found in the trash. Deer killed farther from the site would have been field dressed and only the meatier portions and those useful for tools would have found their way into archeological deposits. These skeletal portions would be over-represented in the archeological record.

Results

Data were analyzed for Late PIII only. They indicate that the less meaty portions of the skeleton, the skull, neck and ribs, were under-rep-

Table 63. Skeletal elements of mule deer identified, Late PIII.

			Right	Left	Indeterminate
Skull:	*Temporal*		*2*	*1*	
	Parietal		*1*		*1*
	Occipital		*3*		*4*
	Calvarium	*3*			
Face:	*Mandible*		*6*	*1*	*2*
	Nasal	*1*			
	Maxillary		*3*	*3*	
	Orbit		*1*	*1*	*2*
Vertebrae:	*Cervical*	*10*			
	Thoracic	*29*			
	Lumbar	*32*			
	Sacral	*1*			
	Atlas	*1*			
	Axis	*4*			
	Indet. Frags.	*12*			
Thorax:	*Ribs*		*3*	*4*	*36*
	Sternum	*7*			
	Scapula		*3*	*14*	*1*
	Pelvis		*10*	*9*	*1*
Humerus:	*Proximal*		*3*	*2*	*1*
	Distal		*5*	*11*	
Radius:	*Proximal*		*8*	*5*	
	Distal		*4*	*4*	
Ulna			*8*	*4*	
Patella		*1*			
Femur:	*Head*		*1*	*1*	
	Proximal		*2*	*4*	
	Distal		*5*	*7*	
Tibia:	*Proximal*		*5*	*8*	
	Distal		*7*	*6*	*1*
Carpal		*7*			
Metacarpal		*14*			
Tarsal		*5*			
Metatarsal		*15*			
Astragalus		*9*			
Calcaneum		*13*			
Phalanges		*58*			
Hoof Fragment		*1*			
Antler		*9*			

resented in the mule deer skeletal elements (Table 63), confirming the hypothesis.

Differences between numbers of elements representing the different portions of the animal suggest cultural selection (White 1952), providing differential preservation is not a problem. The number of individuals represented is determined by the greatest number of individuals represented by a specific element. On this basis, the data indicate that two or three individuals are represented by the remains of the skull, cervical vertebrae, thoracic vertebrae and thorax. The pelvic remains and extremities represent eight to 11 animals. The mandible, containing the meaty tongue, represents six animals, double the number represented by the skull.

The non-randomness of the scapulae from the site pose an additional problem. Not only does this bone represent the highest frequency of individuals at the site, but the two sides of the animal are unevenly represented: 14 on the left, only three on the right. Since meat around this bone is easily stripped off and the bone itself is particularly heavy, we would expect there to be a reason for its transportation to Antelope House. Its use as a tool, possibly as an attachment to a digging stick, is hypothesized.

The analysis of mule deer remains was not

repeated for other species because of the disproportionate role of mule deer in fulfilling the meat needs of the inhabitants of the site, as illustrated in Table 64. The data are recalculated from data supplied by Sparling, Dirst and Hamblin. Percentages were calculated from the MNI for each period, using the following values for pounds of usable meat per skeleton (White 1953: 396–398): mule deer, 100; pronghorn, 55; bighorn, 100; dog, 12.5; jackrabbit, 3; cottontail, 1.75.

There is no major change in the percentage of a given species hunted through time, other than an increase in antelope and a corresponding decrease in deer during Early PIII times. The increase in antelope during Middle PIII may relate to the drought which occurred at that time. The antelope population living at lower elevations would have declined and deer may have been more easily hunted as they clustered near water.

It is obvious that venison was the principal wild meat consumed, supplemented by other species. If bears were consumed at Antelope House, their contribution would have been considerable but sporadic; the available meat from one grizzly bear (204 kg) is greater than that provided by all the rabbits, prairie dogs and packrats recovered throughout the occupation of the site. The large artiodactyls—bighorn, antelope and mule deer—provided 94 percent of the hunted meat consumed at the site. Everything else can be considered occasional snacks. Although small animals would have been important on a meal-to-meal basis, the abundance of the artiodactyls, especially deer, shaped the character of the diet.

Since dogs were present at Antelope House and since they have chewed numerous bone fragments at the site, their effect on the faunal assemblage must be considered. In general, they would have removed significant amounts of the smaller animals, especially cottontails, jackrabbits and turkeys (Charmion McKusick 1975: personal communication). It is reasonable to assume, therefore, that these three species are under-represented in the data. Their relative proportions, however, would be unaltered; turkeys were more abundant than either type of rabbit. Although under-represented, a tremendous increase in the number of rabbits consumed would be necessary before the essential conclusions presented above would be changed. These data could be used for comparison with other Southwestern sites, since dogs and their bone-destroying capabilities would have been present elsewhere.

Table 64. Percentages of meat supplied by six major species.

Species	*PII*	*EPIII*	*MPIII*	*LPIII*
mule deer	57%	45%	67%	63%
pronghorn	10%	25%	8%	14%
bighorn	10%	15%	15%	11%
dog	20%	11%	6%	4%
jackrabbit	1%	3%	2%	3%
cottontail	1%	1%	1%	5%

In a sense, it makes little difference whether any of the smaller mammals (squirrels and the like) were consumed. They simply could not be of great importance in the overall picture. Not so with the larger carnivores, such as the grizzly discussed above, since a single kill would have made an enormous amount of meat available for consumption in a relatively short period, even if the meat were jerked for storage. This suggests that the amount of wild meat varied widely in the diet, ranging from over-abundance to absence, especially in Middle PIII times. The staple diet would have been vegetal, as noted by Lee and Devore (1968) for hunting-and-gathering groups in general. Domestic turkeys and dogs were additional sources of meat at Antelope House.

Chapter 14

Human Coprolites

Method

The analysis of 91 desiccated fecal specimens of probable human origin from Antelope House is reported here. Specimens were selected for diet and parasite analysis on the basis of well-established criteria (Fry 1970a, 1970b, 1971, 1973; Hall 1972), including general form and size, color, visible contents and the property of turning the immersing fluid dark brown or black. Smell is often another good criterion (Bryant 1974a). Although selection of probable human samples is the most subjective aspect of coprolite analysis, we feel reasonably certain that the selected samples are of human origin.

Analytical procedures employed here were developed and refined over years of fecal analysis and are based on the work of Callen (1963), Fry (1968, 1970a), Fry and Hall (1969) and Hall (1972) (see also: Van Cleve and Ross 1947; Benninghoff 1947; Callen and Cameron 1955; Colyer and Osborne 1965; Heizer and Napton 1969; Bryant 1975). The history of coprolite analysis has been detailed by Heizer and Napton (1969), Fry (1968, 1970a), Hall (1972) and Bryant (1974a, 1974b).

Samples were described in detail, photographed, measured and weighed; extraneous outer material (rocks, sticks, etc.) was removed. A small sample (2–4 g) was removed from the specimen and hydrated for a minimum of 72 hours in a 0.5 percent w/v aqueous solution of trisodium phosphate (Na_3PO_4). The sample next was washed through graded geological sieves (1.0 mm and 0.25 mm), dried, weighed and separated into discrete components, which were individually weighed and computed as percentage weights of the screened total. Residue passing through the fine sieve was collected and microscopically examined for parasites and ova. Although this method is tedious and time consuming, it yields quantitative results which may be suitable for statistical analysis (Fry and Adovasio 1970; Gunn 1975; Marquardt 1974).

There are some problems (Fry 1970a, 1970b). Recovered components obviously represent undigested dietary fragments and do not demonstrate absolute diet composition. However, they are the remains of actual meals and are, therefore, indicative of prehistoric dietary habits. The results are especially valuable for comparison with other types of archeological data (e.g., plant macrofossils or pollen) in the reconstruction of prehistoric ecosystems.

Watson (1974: 239–241) discusses additional problems. (1) Does a fecal specimen represent one or several meals? We believe it is legitimate to treat a coprolite as a meal if there are no discrete visual differences between different sections of the specimen. Further, meal types (Fry 1974) should be based on percentage weights of major components (those making up most of the weight), while minor constituents (those represented by only a trace or a tiny percentage weight) should be viewed as possible residuals from earlier meals or simply as minor meal com-

ponents and as important, therefore, only in terms of presence or absence. (2) How should we quantify fecal components? As noted above, fecal components represent undigested food remains; these have different absorption rates, according to individual digestive characteristics, individual component characteristics and different food preparation techniques. Watson suggests we establish seed number/weight ratios. This method also has inherent problems. Seed size and density (wt/seed) vary from plant to plant among individuals of the same species and between seed clusters on the same plant, and there are variations caused by differences in food preparation. We found that seed count/weight ratios vary greatly for the same seed variety between coprolite specimens.

Finally, as noted by Napton and Heizer (1970), sample error may lead to skewed conclusions. This is a problem at Antelope House, since samples were selected for analysis prior to dating of some structures. In addition, many rooms are represented by single specimens and some are not represented at all, which could be due to varying aboriginal defecation habits or to sampling method. Specimen selection was entirely non-random. Further, it is impossible to know if the sample from a given unit is representative of the population.

Despite analytical problems, coprolite analysis remains an extremely valuable information source for human paleoecology.

The Data

The weight of every component for each screen from every coprolite examined was recorded, as noted earlier, but the sheer bulk of the data necessitates tabular presentation. Since each sample is of a different size and weight, visual comparison of component weights is difficult and virtually meaningless. Therefore, we have converted all weights to percentages for comparison of samples by totaling the weights of each component from both screens and dividing by the sample weight. The total percentage weights are presented in Table 65. Only three rooms contained sufficient specimens for comparison: Rooms 21, 29 and 42. Accordingly, T. Volman, Department of Anthropology, University of Chicago, performed some statistical tests based on component presence/absence. Two-by-two contigency tables were generated using chi-square, Phi and Kendall's Tau. Few of the tests showed significance. Therefore, the data are best compared by simple visual examination of individual specimen components (Table 65), complemented by presence/absence data (Table 66). Raw data are stored at the Western Archeological Center, National Park Service, Tucson.

Proveniences of Antelope House coprolites are listed in Table 67. Coprolites are grouped by period, room block and room number in Table 68. Scientific and common names of identified plant components are listed in Table 69. Common names are used throughout the discussion. Botanical sources used in this report are Cutler (1966), Cutler and Bower (1966), Jennings (1966), Kaplan (1956), Kearney and Peebles (1964), Lundel *et al.* (1969), Martin and Barkley (1961) and Vickery (n.d.). The primary ethnobotanical source used in discussion of identified plant components is Whiting (1966), unless otherwise cited.

Coprolite Components

The abbreviation AH will be used hereafter to designate Antelope House coprolites. Identified plant components for AH coprolites are compared with those from Inscription House coprolites (hereafter IH) and with Anasazi coprolites from 10 sites in Glen Canyon (hereafter GC) in Table 70. Inscription House samples (Fry and Hall 1973) are ascribable to Late Pueblo III times. The Glen Canyon samples (Fry 1970a) are, for the most part, ascribable to PII—PIII times. Two sites are Basketmaker II, but for comparative purposes all are lumped under the GC heading.

Amaranth seeds, present as minor components in 10 percent of AH samples, are eaten by the Hopi and were common in GC coprolites. Beans, found in a single AH coprolite, are a major food for the Hopi and are present in four IH samples. It is probable that beans generally are destroyed in the digestive process. Consumption of beeweed seeds, present in 16 percent of the AH coprolites and in 17 percent of GC coprolites, is not reported for the Hopi, but the plant is an important cultivar and is itself eaten and utilized in ceremonies. Cactus epidermis and spines are present in 42 percent of AH coprolites and are a major component of some samples; these parts are present in 50 percent of IH coprolites. Fruits, joints and roots of several

Table 65. Total percentage weights of coprolite components.

Sample	*48*	*85*	*49*	*51*	*52*
Time	*PI*	*PII*	*PII*	*PII*	*PII*
Room	*St. 74*	*Kiva D*	*St. 73*	*St. 73*	*St. 73*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
cactus epidermis	—	—	—	—	13.54
cactus spine	—	—	.07	—	—
corn	50.77	1.52	53.50	8.27	.12
cotton seed	—	—	—	.03	—
grape seed	—	—	—	.92	—
ground cherry seed	—	—	.10	.35	—
pine nut fragments	—	—	20.23	1.76	—
prickly pear seed	—	—	2.17	56.14	—
purslane seed	.01	—	—	—	.94
squash seed	11.99	—	—	3.80	—
sunflower seed	—	—	—	—	.23
plant epidermis	—	1.96	.24	—	—
plant fiber	4.56	.16	1.92	1.85	3.44
bone fragments	—	.45	—	.85	—
charcoal	.16	—	.24	.50	—
feather	.11	—	—	—	—
grit	12.47	—	18.28	12.79	1.78
? concretions	—	—	—	—	2.40
? hair	.20	.01	.08	.05	—
insect parts	—	—	—	.14	—
resin	.55	—	—	—	—
debris	19.08	95.88	3.12	12.56	77.55

Sample	*37*	*38*	*39*	*40*	*41*
Time	*PII*	*PII*	*PII*	*PII*	*PII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
amaranth seed	—	—	.07	—	—
beeweed seed	—	—	.43	—	—
cactus epidermis	—	.48	—	—	—
cactus spine	.01	—	.01	—	—
corn	65.90	78.16	50.23	53.53	40.04
ground cherry seed	—	2.88	—	.80	—
pine nut fragments	16.54	8.51	—	—	13.33
purslane seed	—	.04	—	.42	.11
squash seed	.80	.37	4.78	—	1.10
? seed	.04	—	—	—	—
plant epidermis	.26	—	.15	—	2.76
plant fiber	.72	1.03	.91	1.52	3.32
plant stem	—	—	—	.45	—
bone fragments	—	—	.80	.14	.36
charcoal	.31	.16	.06	.10	.11
? feather	—	.01	—	.01	.01
grit	8.33	8.12	29.26	31.17	20.84
human hair	—	—	—	—	.01
? hair	.06	.05	.04	.06	—
insect case	—	—	—	—	.98
grasshopper parts (Melanoplus)	—	—	—	6.80	—
resin	3.76	—	—	—	—
debris	2.87	.21	13.27	5.01	17.04

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*42*	*43*	*44*	*45*	*46*
Time	*PII*	*PII*	*PII*	*PII*	*PII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
amaranth seed	—	.23	—	—	—
beeweed seed	—	.14	—	.11	—
cactus epidermis	—	2.68	—	—	—
cactus spine	—	—	—	—	.04
corn	55.78	34.30	15.23	39.02	48.26
ground cherry seed	.34	—	.43	—	2.00
panic grass seed	—	—	—	—	.07
pine nut fragments	.16	—	2.27	1.82	22.29
prickly pear seed	—	4.11	—	—	7.22
purslane seed	.14	.34	.33	.29	—
squash seed	4.53	1.83	—	2.52	1.39
yucca seed	.80	—	—	—	—
? seed	—	—	—	.88	—
plant epidermis	—	—	—	.35	
plant fiber	.76	1.94	3.98	5.08	1.04
plant stem	—	—	.03	—	—
beetle (Niptus)	—	.17	—	.39	—
bone fragments	.73	10.65	—	.39	1.50
charcoal	—	.19	.80	.07	.20
grit	28.75	31.85	45.49	32.23	10.74
human hair	0.01	—	—	—	—
? hair	—	.03	—	.01	—
insect parts	—	—	—	—	.01
debris	7.99	11.53	31.38	17.20	5.24

Sample	*47*	*25*	*28*	*29*	*30*
Time	*PII*	*EPIII*	*EPIII*	*EPIII*	*EPIII*
Room	*21*	*29*	*29*	*29*	*29*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
beeweed seed	—	—	—	.30	—
cactus epidermis	—	.54	—	—	4.69
cactus spine	—	—	1.89	—	—
corn	50.90	54.17	65.29	63.47	48.14
goosefoot seed	.01	—	—	—	—
ground cherry seed	—	.46	—	—	.59
pine nut fragments	.34	—	—	—	—
purslane seed	.17	—	.31	.08	.23
squash seed	6.33	—	—	.11	—
? seed	.21	—	—	—	—
plant epidermis	1.60	.35	.01	.03	—
plant fiber	—	1.78	1.60	1.09	4.09
plant stem	.01	—	.15	1.17	—
beetle (Niptus)	—	—	—	.18	—
bone fragments	—	.15	1.99	—	—
bone (bird?)	—	—	—	6.74	—
charcoal	1.36	.69	11.72	.19	.12
feather	—	—	—	—	.24
grit	11.73	10.42	16.94	24.29	16.58
human hair	—	.01	—	—	.06
? hair	.11	—	—	2.21	—
debris	27.14	31.90	—	.12	25.27

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*31*	*83*	*78*	*01*	*02*
Time	*EPIII*	*EPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*29*	*77*	*82*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
araranth seed	—	—	.22	.01	.58
cactus epidermis	—	—	—	7.41	—
cactus spine	—	—	—	.07	—
corn	27.30	78.98	22.70	61.99	75.28
dropseed seed	—	—	—	.02	—
horsebrush stem	—	—	—	5.83	—
Indian rice grass seed	—	—	—	.56	—
purslane seed	—	—	—	—	.15
saltbush leaf fragment	—	—	6.25	—	—
? leaf fragment	—	.94	—	—	—
plant epidermis	—	.32	.09	—	—
plant fiber	.07	.72	.50	2.44	1.33
plant stem	—	.60	—	—	2.36
bone fragment	—	.09	2.32	—	—
charcoal	.12	.31	.27	.82	.30
feather	.06	—	—	4.01	.03
grit	23.50	16.66	—	16.76	6.31
human hair	.13	—	—	—	—
? hair	.02	.13	.26	.04	1.56
insect parts	.07	—	—	—	—
debris	48.74	1.25	67.39	—	12.10

Sample	*03*	*04*	*05*	*06*	*07*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
amaranth seed	2.00	—	—	—	—
cactus spine	—	—	—	.06	—
corn	74.81	28.77	7.33	21.84	44.44
ground cherry seed	—	—	.03	—	—
horsebrush stem	.88	—	—	—	—
Indian rice grass seed	—	—	—	52.95	—
pine nut fragment	—	5.09	—	—	—
prickly pear seed	—	—	76.66	—	—
? seed	.36	—	—	—	—
plant epidermis	—	.35	—	8.98	3.17
plant fiber	3.31	.17	.10	2.93	.58
plant stem	.44	—	—	—	—
bone fragment	—	—	.41	—	11.17
charcoal	.31	—	.14	.06	1.07
feather	.02	—	—	—	.01
grit	3.40	6.51	5.36	4.77	12.93
human hair	.01	—	—	.02	—
? hair	1.29	5.20	2.95	—	.95
insect parts	.02	—	—	—	—
small stones	—	37.97	—	—	—
debris	13.15	15.95	7.02	8.39	25.68

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*08*	*09*	*10*	*11*	*12*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
amaranth seed	.23	—	—	.09	.79
cactus epidermis	—	—	21.51	5.40	—
corn	85.44	18.69	—	43.41	75.93
dropseed seed	—	—	—	—	.38
goosefoot seed	—	—	.45	—	—
grass seed	—	—	—	.12	—
ground cherry seed	.04	—	—	—	—
horsebrush stem	—	—	—	1.51	—
pepper grass seed	—	—	62.12	—	—
prickly pear seed	1.72	74.83	—	—	—
purslane seed	—	—	—	—	.07
squash seed	3.05	.15	—	—	—
sunflower seed	—	—	.12	—	—
? seed	—	.26	—	.89	.35
plant epidermis	—	.29	—	.25	.52
plant fiber	1.13	.18	—	1.47	.92
bone	—	3.02	—	—	—
beetle (Niptus)	—	.01	—	.33	—
charcoal	.37	.03	.04	.68	2.30
feather	—	.02	—	—	.02
feather (turkey)	—	—	—	.03	—
grit	8.00	2.25	15.65	30.2	18.71
? hair	.02	.28	.10	—	.01
debris	—	—	—	15.61	—

Sample	*13*	*14*	*15*	*16*	*64*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
beeweed seed	—	—	—	20.07	—
cactus epidermis	—	2.17	1.93	—	—
cactus spine	—	.52	—	.06	—
corn	92.97	67.33	40.94	64.55	19.57
horsebrush stem	—	—	—	6.05	—
Indian rice grass seed	—	—	.23	—	—
pine nut fragment	—	—	—	—	10.02
prickly pear seed	—	—	14.85	—	—
purslane seed	1.88	—	—	—	—
squash seed	—	—	.27	—	—
squawbush seed	—	3.18	—	—	—
? flower	—	—	—	—	.03
? seed (charred)	—	—	1.23	—	—
plant epidermis	—	—	—	—	1.27
plant fiber	.79	1.30	2.55	1.32	2.81
plant stem	2.37	—	.37	—	—
bone fragment	—	.11	—	2.22	21.97
charcoal	—	.37	.51	.51	.33
feather	—	.06	—	.02	—
grit	1.94	8.97	19.48	5.08	.08
? hair	—	.06	1.62	.02	.05
insect parts	.06	.26	—	.08	—
resin	—	—	.71	—	—
sinew	—	—	—	—	1.77
debris	—	15.68	15.31	—	42.09

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*65*	*66*	*67*	*68*	*69*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*21*	*21*	*21*	*21*	*21*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
cactus epidermis	—	—	2.02	—	—
corn	78.68	82.56	30.50	2.84	2.84
cotton seed	.27	.29	—	—	—
grape seed	—	2.40	—	—	—
pine nut fragment	—	—	—	68.34	71.00
squash seed	5.36	7.18	—	—	—
? seed	—	—	.60	—	—
plant epidermis	13.97	—	1.49	—	—
plant fiber	1.10	1.58	4.50	.79	.99
charcoal	—	.15	4.63	—	—
feather	—	—	—	—	.04
debris	.61	5.84	56.27	28.03	25.12

Sample	*70*	*71*	*72*	*80*	*86*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*21*	*21*	*23*	*23*	*23*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
cactus epidermis	—	—	—	—	2.13
cactus spine	—	—	—	—	.28
corn	97.57	25.31	33.96	71.54	—
cotton seed	—	27.71	—	—	—
pine nut fragment	—	—	.46	16.33	—
squash seed	—	—	—	.91	—
plant epidermis	—	1.69	.03	—	2.23
plant fiber	.03	.15	.46	1.80	.63
charcoal	—	.04	.17	.32	.34
grit	—	—	36.91	—	—
? hair	—	.02	.08	.05	.30
insect parts	.02	—	—	—	—
? sinew	—	4.39	—	—	—
debris	2.38	40.69	27.93	9.04	94.06

Sample	*17*	*18*	*19*	*20*	*21*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*29*	*29*	*29*	*29*	*29*
Room Block	*S*	*S*	*S*	*S*	*S*
Components:					
beeweed seed	—	.22	—	—	1.10
cactus epidermis	—	—	—	—	5.99
cactus spine	—	—	—	—	.03
corn	78.84	12.39	71.05	11.14	7.70
cotton seed	—	—	1.81	—	24.14
goosefoot seed	—	—	.17	—	—
pine nut fragments	8.13	—	10.03	—	—
squash seed	—	—	3.70	10.57	—
squawbush seed	—	—	—	—	1.41
plant fiber	.95	5.60	.62	1.65	2.27
plant stem	.71	—	.22	—	—
woody stem frag.	—	.40	—	—	—
bone fragment	6.00	—	.11	—	3.58
charcoal	.22	.29	.07	.09	1.67
grit	.22	.84	11.31	.72	.65
? hair	1.83	.05	.70	.05	.01
insect pupae case	—	—	.21	—	—
debris	3.09	80.21	—	75.78	51.45

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	22	23	24	26	27
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	29	29	29	29	29
Room Block	S	S	S	S	S
Components:					
bean epidermis	—	—	—	—	6.11
beeweed seed	—	.28	.70	—	.15
cactus epidermis	—	—	2.57	—	—
cactus spine	.23	.25	.04	—	—
corn	38.13	53.05	1.46	12.75	18.89
cotton seed	8.33	13.98	5.34	—	23.39
purslane seed	—	—	—	.19	—
squawbush seed	4.88	14.81	—	2.32	22.02
sunflower seed	.36	.36	—	—	—
? seed	.60	—	5.09	—	—
plant epidermis	—	—	—	3.38	—
plant fiber	1.90	1.48	2.10	3.92	1.50
plant stem	—	—	—	.56	—
bone fragment	2.02	.05	—	—	—
charcoal	1.72	2.86	1.26	.10	.83
grit	.85	.74	—	10.77	.16
human hair	—	—	—	.06	—
debris	41.00	12.10	81.45	65.94	26.95

Sample	32	33	34	35	36
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	29	29	29	29	29
Room Block	S	S	S	S	S
Components:					
cactus epidermis	12.64	1.62	—	—	73.36
cactus fiber	—	—	—	—	8.57
cactus spine	2.27	.03	.25	—	.19
corn	—	40.40	38.69	38.80	—
cotton seed	—	2.77	—	—	—
pine nut fragment	—	22.38	13.20	4.16	—
prickly pear seed	—	—	—	10.49	—
wild rye	—	—	.01	—	—
plant epidermis	—	—	—	—	15.64
plant fiber	5.67	3.07	10.46	1.44	—
plant stem	—	.59	1.87	—	—
woody stem	—	—	—	.40	—
bone fragment	1.18	3.38	.09	—	—
charcoal	.27	.22	.05	.17	.03
feather	—	1.46	—	—	.01
grit	6.88	20.67	17.15	33.57	2.20
human hair	—	.01	.16	—	—
? hair	.01	.02	.04	.05	—
insect parts	.08	—	—	—	—
string	—	.80	—	—	—
debris	71.00	2.59	18.04	10.92	—

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*75*	*77*	*79*	*53*	*54*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*St. 89*	*26*	*33*	*42*	*42*
Room Block	*C*	*C*	*C*	*C*	*C*
Components:					
cactus epidermis	—	4.59	—	—	—
cactus spine	—	.08	—	—	—
corn	22.81	6.07	3.20	86.56	1.06
cotton seed	—	4.58	—	—	—
horsebrush stem	—	—	—	9.06	—
pine nut fragment	.29	—	—	—	—
squash seed	—	—	2.11	.02	—
? seed	.32	—	—	—	—
plant epidermis	4.91	1.70	—	4.29	1.35
plant fiber	.22	.84	.55	—	59.77
plant stem	—	—	—	.07	.05
beetle (Niptus)	—	—	.27	—	—
bone fragment	16.81	—	—	—	—
charcoal	.64	.48	8.86	—	2.43
grit	39.68	—	7.05	—	12.21
hair	—	.03	—	—	—
? hair	1.01	—	.15	—	.36
insect parts	—	—	—	—	.56
debris	13.32	81.62	77.81	—	22.21

Sample	*55*	*56*	*57*	*58*	*59*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*42*	*42*	*42*	*42*	*42*
Room Block	*C*	*C*	*C*	*C*	*C*
Components:					
beeweed seed	2.32	—	—	—	—
cactus epidermis	—	—	—	1.06	—
cactus spine	—	—	.06	.02	.52
corn	9.12	34.15	2.66	77.70	32.84
dropseed seed	4.21	—	—	—	—
ground cherry seed	11.40	—	.27	—	—
pine nut fragment	—	—	.34	—	11.32
prickly pear seed	—	—	—	2.90	.30
purslane seed	1.28	—	—	—	—
squash (epidermis)	—	—	—	—	8.38
plant epidermis	—	2.90	.10	—	—
plant fiber	5.80	4.47	2.32	.55	1.40
plant stem	.59	.11	—	—	.37
beetle (Niptus)	.40	—	.03	—	—
feather	—	—	—	.36	—
grit	—	.23	76.40	16.70	31.56
charcoal	—	—	2.09	.60	.57
? hair	—	—	—	.12	.02
insect parts	—	.06	—	—	—
debris	64.88	58.07	15.74	—	12.72

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*60*	*61*	*62*	*63*	*82*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*42*	*42*	*42*	*42*	*42*
Room Block	*C*	*C*	*C*	*C*	*C*
Components:					
beeweed seed	—	1.70	—	—	—
cactus spine	—	—	—	.17	—
corn	3.79	—	61.21	12.44	92.09
cotton seed	—	—	22.54	—	.55
goosefoot seed	—	.64	—	—	—
ground cherry seed	—	12.42	—	—	—
pine nut fragment	.66	—	.21	—	—
purslane seed	.14	5.63	—	—	—
squash seed	1.32	—	—	—	—
? seed	.14	—	—	—	—
plant epidermis	.26	4.70	.26	.83	3.75
plant fiber	7.59	11.90	.27	4.08	—
plant stem	—	—	—	.96	—
bone fragment	—	—	11.62	—	—
charcoal	.73	.55	.09	1.21	—
feather (turkey)	—	—	—	.07	—
grit	43.37	—	—	33.73	—
human hair	—	—	.02	—	.29
? hair	.01	—	.04	.12	—
insect (grasshopper)	—	—	—	2.32	—
debris	42.00	62.46	3.74	44.09	3.33

Sample	*89*	*90*	*91*	*92*	*74*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*45*	*81*	*5*	*18*	*19*
Room Block	*C*	*C*	*N*	*N*	*N*
Components:					
amaranth seed	.05	—	—	—	—
beeweed seed	—	—	—	36.62	—
cactus epidermis	—	58.99	1.98	—	—
cactus spine	.04	2.56	.24	—	.06
corn	9.19	—	—	2.20	32.75
cotton seed	—	—	.95	—	1.82
horsebrush stem	1.01	—	15.00	—	—
onion epidermis	—	—	1.36	—	.01
squash seed	.91	—	—	—	—
? seed	—	—	.02	—	—
plant epidermis	1.25	7.68	—	—	.35
plant fiber	7.10	2.56	—	2.35	2.91
plant stem	—	—	.80	—	—
bone fragment	—	—	—	.39	—
charcoal	—	—	—	—	.99
hair	.22	2.56	—	.15	.02
? hair	—	—	.02	—	–
insect parts	.34	25.66	—	—	—
grit	1.13	—	—	.28	13.71
debris	78.75	—	79.61	58.01	47.38

continued

Table 65. Total percentage weights of coprolite components—Continued

Sample	*76*	*84*	*81*	*87*	*88*
Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room	*35*	*35*	*47*	*47*	*No. Trench*
Room Block	*N*	*N*	*N*	*N*	*N*
Components:					
beeweed seed	32.40	—	—	—	—
cactus epidermis	—	—	—	—	5.21
cactus spine	—	—	2.73	—	.16
corn	.38	85.29	66.70	85.68	7.52
squash seed	—	—	.20	—	—
plant epidermis	3.05	.51	6.48	2.67	—
plant fiber	—	.49	5.62	.84	.16
plant stem	.20	—	—	3.90	—
bone fragment	—	—	—	—	.27
charcoal	—	.59	7.24	.59	.16
feather (turkey)	—	—	—	.02	.06
grit	2.94	13.11	8.20	—	—
? hair	.27	.01	2.73	.31	.19
insect parts	—	—	.10	.29	.38
debris	60.81	—	—	5.71	85.88

Sample	*73*
Time	*Navajo*
Room	*9*
Room Block	*S*
Components:	
amaranth seed	.18
cactus epidermis	.54
cactus spine	.03
corn	.12
goosefoot seed	.36
plant fiber	.09
bone fragment	8.33
charcoal	.03
grit	7.32
? hair	.36
debris	82.63

Table 66. Presence/absence of identified plant components.

Time	*PI*	*PII*	*PII*	*PII*	*EPII*
Room Block	*S*	*S*	*S*	*S*	*S*
Room No.	*St. 74*	*Kiva D*	*St. 73*	*21*	*21*
Total N.	*1*	*1*	*3*	*11*	*5*
Components:					
amaranth seed	—	—	—	2	—
beeweed seed	—	—	—	3	1
cactus epidermis/spines	—	—	2	5	3
corn	1	1	3	11	5
cotton seed	—	—	1	—	—
goosefoot seed	—	—	—	1	—
grape seed	—	—	1	—	—
ground cherry seed	—	—	2	5	2
panic grass seed	—	—	—	1	—
pine nut shell fragments	—	—	2	8	—
prickly pear seed	—	—	2	2	—
purslane seed	1	—	1	8	3
squash seed/tissue	1	—	1	9	1
sunflower seed	—	—	1	—	—
yucca seed/pod fragments	—	—	—	1	—
? seed	—	—	—	3	—

Time	*EPII*	*MPIII*	*LPIII*	*LPIII*	*LPIII*
Room Block	*S*	*S*	*S*	*S*	*S*
Room No.	*77*	*82*	*21*	*23*	*29*
Total N.	*1*	*1*	*24*	*3*	*15*
Components:					
amaranth seed	—	1	6	—	—
bean epidermis	—	—	—	—	1
beeweed seed	—	—	1	—	5
cactus epidermis/spines	—	—	8	1	8
corn	1	1	23	2	13
cotton seed	—	—	3	—	7
dropseed seed	—	—	2	—	—
goosefoot seed	—	—	1	—	1
grape seed	—	—	1	—	—
grass family seed	—	—	1	—	—
ground cherry seed	—	—	2	—	—
horsebrush stem	—	—	4	—	—
Indian rice grass seed	—	—	3	—	—
peppergrass seed	—	—	1	—	—
pine nut shell fragments	—	—	4	2	5
prickly pear seed	—	—	4	—	1
purslane seed	—	—	3	—	1
saltbush leaf	—	1	—	—	—
squash seed/tissue	—	—	5	1	2
squawbush seed	—	—	1	—	5
sunflower seed	—	—	1	—	2
wild rye	—	—	—	—	1
? seed	—	—	6	—	2

continued

Table 66. Presence/absence of identified plant components—Continued

Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room Block	*C*	*C*	*C*	*C*	*C*
Room No.	*St. 89*	*26*	*33*	*42*	*45*
Total N.	*1*	*1*	*1*	*12*	*1*
Components:					
amaranth seed	—	—	—	—	1
beeweed seed	—	—	—	2	—
cactus epidermis/spines	—	1	—	4	1
corn	1	1	1	11	1
cotton seed	—	1	—	2	—
dropseed seed	—	—	—	1	—
goosefoot seed	—	—	—	1	—
ground cherry seed	—	—	—	3	—
horsebrush stem	—	—	—	1	1
pine nut shell fragments	1	—	—	4	—
prickly pear seed	—	—	—	2	—
purslane seed	—	—	—	3	—
squash seed/tissue	—	—	1	3	1
? seed	1	—	—	1	—

Time	*LPIII*	*LPIII*	*LPIII*	*LPIII*	*LPIII*
Room Block	*C*	*N*	*N*	*N*	*N*
Room No.	*81*	*5*	*18*	*19*	*35*
Total N	*1*	*1*	*1*	*1*	*2*
Components:					
beeweed seed	—	—	1	—	1
cactus epidermis/spines	1	1	—	1	—
corn	—	—	1	1	2
cotton seed	—	1	—	1	—
horsebrush stem	—	1	—	—	—
onion epidermis	—	1	—	1	—
? seed	—	1	—	—	—

Time	*LPIII*	*LPIII*	*Navajo*
Room Block	*N*	*N*	*S*
Room No.	*47*	*N. Trench*	*9*
Total N	*2*	*1*	*1*
Components:			
amaranth seed	—	—	1
cactus epidermis/spines	1	1	1
corn	2	1	1
goosefoot seed	—	—	1
squash seed/tissue	1	—	—

species of cactus are eaten by the Hopi, after removal of spines by burning.

Corn, present in 91 percent of AH specimens and a major component of many, was the most important Hopi food. It was often eaten green (i.e., "off the cob") at Antelope House. It is present, often as a major component, in 63 percent of IH coprolites and in 60 percent of GC samples. Cotton seed, found in 18 percent of AH coprolites and a major component in several, is not reported as a Hopi food, but the plant was of great technological and ceremonial importance. Cotton seed was found in 25 percent of IH samples and in 30 percent of GC specimens. Dropseed seed is a minor component of a single AH coprolite and is present in 19 percent of IH samples. Several species of dropseed were utilized by the Hopi. Goosefoot (cf. lambsquarter) seed

Table 67. Provenience of human coprolites examined.

N	*Provenience*	*Analysis Number*	*Room No.*	*Date*	*Room Block*
1	039	73	9	Navajo	S (area)
1	155	85	Kiva D	PII	S (area)
2	189	49, 51	Structure 73	PII	S (area)
1	190	52	Structure 73	PII	S (area)
1	194	48	Structure 74	PI	S Plaza
1	234	82	42	LPIII	C
11	236	53–63	42	LPIII	C
2	307	70, 71	21	LPIII	S
2	312	68, 69	21	LPIII	S
16	329	1–16	21	LPIII	S
4	336	64–67	21	LPIII	S
9	350	37–45	21	PII	S
2	351	46–47	21	PII	S
1	471	84	35	LPIII	N
1	481	76	35	PIII	N
1	538	88	N–TR	LPIII	N
1	574	92	18	LPIII	N
1	588	89	45	LPIII	C
1	604	81	47	LPIII	N
1	733	79	33	LPIII	C
1	1026	91	5	LPIII	N
1	1113	77	26	LPIII	C
1	1142	74	19	LPIII	N
1	1151	87	47	LPIII	N
5	1171	17–21	29	LPIII	S
5	1173	22–24, 26–27	29	LPIII	S
1	1222	83	77	EPIII	S (area)
1	1246	86	23	LPIII	S
5	1269	32–36	29	LPIII	S
5	1294	25, 28–31	29	EPIII	S
1	1329	75	Structure 89	LPIII	C
1	1401	80	23	(LPIII)	S
1	1438	78	82	MPIII	S
1	1527	90	81	LPIII	C
1	1540	72	23	LPIII	S
91 Total					

is present in 4 percent of AH coprolites as a minor constituent and in 53 percent of GC samples. Goosefoot seeds of many species were utilized by the Hopi. Single grape seeds were found in two AH coprolites and apparently were not a major food resource. Grass family seed is present in a single AH specimen, in 6 percent of IH coprolites and in 47 percent of GC samples. Several grasses are utilized by the Hopi. Ground cherry seed is present in 16 percent of AH coprolites and in 13 percent of IH samples. Ground cherry fruit reputedly was eaten by the Hopi in the past. Horsebrush stem is a component of 7 percent of AH specimens. Horsebrush is reported (unverified) to have been used in a sacred bread by the Hopi. Indian rice grass seed, a major Hopi food, is present in 2 percent of AH samples and in 31 percent of IH coprolites. Wild onion epidermis is present in 2 percent of AH specimens. Prior to the introduction of the domesticated onion, the wild variety was used for flavoring by the Hopi. Panic grass seed is present in a single AH coprolite and in one IH specimen. Pepper grass seed is present in one AH sample. Neither of these grasses is reported as a Hopi food.

Table 68. Total samples by period, room block and room.

Time	*Room Block*	*Room No.*	*N*	*Total No.*
PI	South	Structure 74	1	1
PII	South	Kiva D	1	
PII	South	Structure 73	3	
PII	South	21	11	15
EPIII	South	29	5	
EPIII	South	77	1	6
MPII	South	82	1	1
LPIII	South	21	24	
LPIII	South	23	3	
LPIII	South	29	15	
LPIII	Central	Structure 89	1	
LPIII	Central 26	1		
LPIII	Central	33	1	
LPIII	Central	42	12	
LPIII	Central	45	1	
LPIII	Central	81	1	
LPIII	North	5	1	
LPIII	North	18	1	
LPIII	North	19	1	
LPIII	North	35	2	
LPIII	North	47	2	
LPIII	North	North Trench	1	67
Navajo	South	9	1	1

Table 69. Common and scientific names of identified plant components.

Allium sp.	onion epidermis
Amaranthus sp.	amaranth, pigweed seed
Atriplex confertifolia	saltbush leaf
Cactaceae	cactus family epidermis and spines
Chenopodium sp.	chenopod, goosefoot seed
Cleome serrulata	beeweed seed
Cucurbita sp.	squash seed and tissue
Elymus cf. *pauciflorus*	wild rye
Equisetum cf. *laevigatum*	horsebrush stem
Gossypium hirsutum	cotton seed and fiber
Gramineae	grass family seed
Helianthus sp.	sunflower seed
Lepidium sp.	pepper grass seed
Opuntia sp.	prickly pear seed
Oryzopsis sp.	Indian rice grass seed
Panicum sp.	panic grass seed
Phaseolus cf. *vulgaris*	bean epidermis
Physalis fendleri	ground cherry seed
Pinus sp.	pine nut shell fragments
Pinus sp.	resin
Portulaca sp.	purslane seed
Rhus trilobata	squawbush seed
Sporobolus sp.	dropseed seed
Zea maize	corn seed and tissue
Vitus arizonica	grape seed
Yucca baccata	yucca seed and pod fragments

Table 70. Identified plant components in coprolites from Antelope House, Inscription House and Anasazi sites in Glen Canyon.

Site	*Antelope House*		*Inscription House*		*Glen Canyon*	
Total N	*90*		*16*		*30*	
Component	*N*	*%*	*N*	*%*	*N*	*%*
amaranth	9	10	—	—	10	33
bean	1	1	4	25	—	—
beeweed	14	16	—	—	5	17
bulrush (scirpus)	—	—	—	—	1	3
cactus	38	42	8	50	—	—
cat's eye (*Cryptantha*)	—	—	—	—	1	3
corn	82	91	10	63	18	60
composite (Compositae)	—	—	—	—	8	27
cotton seed	16	18	4	25	9	30
dropseed	1	1	3	19	—	—
goosefoot	4	4	—	—	16	53
grape	2	2	—	—	—	—
grass	1	1	1	6	14	47
ground cherry	14	16	2	13	—	—
hack berry (*celtis*)	—	—	3	19	5	17
horsebrush	6	7	—	—	—	—
Indian rice grass	2	2	5	31	5	17
knotweed (*Polygonum*)	—	—	—	—	1	3
mormon tea (*ephedra*)	—	—	—	—	1	3
onion	2	2	—	—	—	—
panic grass	1	1	1	6	—	—
pepper grass	1	1	9	56	5	17
pine nut	26	29	—	—	1	3
prickly pear	11	12	—	—	16	53
purslane	19	21	1	6	2	7
saltbush	1	1	—	—	—	—
squash	26	29	—	—	20	67
squawbush	6	7	1	6	—	—
sunflower	4	4	3	19	—	—
wild rye	1	1	—	—	—	—
yucca	1	1	—	—	—	—
Total Components:	25		14		18	

Pine nut fragments were found in 29 percent of AH coprolites, often as a major component, and in a single GC specimen. Pine nuts regularly were eaten by the Hopi. Prickly pear seed, representing ingestion of the fruit, is present in 12 percent of AH samples, often as a primary constituent, and in 53 percent of GC coprolites. Fruits, pods and roots of this plant regularly were used by the Hopi. Purslane seed is found in 21 percent of AH specimens, in one IH sample and in two GC specimens. The Hopi cooked the plant in gravy. Saltbush leaves are present in one AH coprolite. The young, tender leaves of several species of saltbush were cooked and eaten as greens by the Hopi. Squash is a common and important Hopi food. Its seed and/or rind is present in 29 percent of AH samples, often as a major component, and its seed and/or tissue is present in 67 percent of GC specimens. Squawbush seed is a component of 7 percent of AH coprolites and of one IH specimen. Berries of squawbush (containing seeds) are brewed into a drink by the Hopi, to whom the plant is technologically and ceremonially important, as is the sunflower. Sunflower seed is a component of 4 percent of AH samples and 19 percent of IH coprolites. Three species of sunflower are utilized by the Hopi, who eat its seeds. Wild rye seed is a minor constituent of one AH specimen. Its use by the Hopi is not reported. Yucca seed and pod fragments are present in one AH coprolite. The fruits are baked in earth ovens and

Table 71. Unidentified plant and nonplant components in Antelope House, Inscription House and Glen Canyon coprolites.

Site	*Antelope House*		*Inscription House*		*Glen Canyon*	
Total N	*90*		*16*		*30*	
Component:	*N*	*%*	*N*	*%*	*N*	*%*
plant epidermis	44	49	3	19	24	80
plant fiber	84	93	16	100	28	93
plant stem	26	29	4	25	13	43
? seed	14	16	6	38	17	57
bone fragments	33	37	4	25	15	50
charcoal	73	81	7	44	25	83
feather	18	20	5	31	6	20
turkey feather	4	4	—	—	—	
grit	69	77	16	100	29	97
? hair	62	69	11	69	20	67
human hair	12	13	3	19	—	—
insect parts	18	20	4	25	11	37
beetle	8	9	1	6	—	—
grasshopper	2	2	—	—	—	—
resin (cf. *Pinus*)	3	3	—	—	2	7
reptile scales	—	—	—	—	1	3
sinew	2	2	—	—	1	3
string	1	1	—	—	—	—
debris	76	85	16	100	30	100

eaten by the Hopi, who use the leaves for basketry and the roots for soap. The plant also has ceremonial importance.

In addition to identified plant components, the coprolites contain a large number of other constituents. These are listed, in comparison with samples from Inscription House and Glen Canyon, in Table 71.

Unidentified plant epidermis is present in 49 percent of AH specimens and is a major component of a few. Plant fiber is present in 93 percent of AH samples and is occasionally a major component. Unidentified plant stem fragments were found in 29 percent of AH samples, nearly always as a minor component. Unidentified seeds of five varieties were recovered from 16 percent of AH coprolites. It is probable that some of these plant categories will be identified in the future. Resin (probably *Pinus* sp.) is present in 3 percent of AH samples. Pine resin has many uses among the Hopi, including medicinal potions.

Non-plant constituents also are regularly found in fecal samples. Bone fragments, which we take to indicate consumption of meat and/or bone cakes, are present in 37 percent of AH coprolites. Bone fragments are present in 25 percent of IH specimens and in 50 percent of GC samples. Of particular interest is a Glen Canyon fecal sample, removed from a mummified Anasazi infant, which contains 55 percent (by weight) bone fragments as part of the last meal (Fry 1970a: 76). Charcoal is present in 81 percent of AH samples, nearly always as a minor constituent, in 44 percent of IH coprolites, and in 83 percent of GC specimens. Charcoal could have been ingested accidentally with food in the form of charred food particles as a result of direct fire roasting or along with small seeds subjected to parching. Tiny feathers are present in 20 percent of AH specimens, in 31 percent of IH samples and in 20 percent of GC coprolites. We suspect that the majority of all AH feathers are those of turkey, since four AH coprolites (4 percent) contain feathers identified as such. Grit, primarily in the form of tiny (less than .255 mm) quartz crystals, is present in 77 percent of AH coprolites, often as a major component, in 100 percent of IH samples, and in 97 percent of GC specimens. Grit may be ingested accidentally as dust or as a result of food processing with grinding stones. In either case, it is never digested and, because of disproportionately large weights, may distort statistical analyses.

Unidentified animal hairs are present in 69

percent of both AH and IH samples and in 67 percent of GC specimens. Hair may be accidentally ingested, as anyone with a pet dog or cat can testify, or may be taken in with meat. Human hair was found in 13 percent of AH specimens and in 19 percent of IH samples. Human hair may be accidentally ingested with food, during grooming activities or during human hair artifact manufacture (e.g., string). Insect parts are present in 20 percent of AH coprolites, 25 percent of IH specimens and 37 percent of GC samples. Most Antelope House insect parts are fragments of coprophageous insects, pupae and egg cases. Nine percent of AH coprolites contain whole skeletons and fragments of the coprophageous Golden Spider beetle, *Niptus ventriculus* (Swan and Papp 1972: 415). One IH specimen also contains parts of this insect. Two AH coprolites contain parts of the Red Legged Grasshopper, *Melanoplus femorubrus* (Swan and Papp 1972: 71). These probably were ingested as food, since the insect is not a coprophageous species. Sinew, probably representing meat ingestion, is present in 2 percent of AH samples and one GC specimen. One coprolite contained a short length of string, undoubtedly not a dietary item. Debris, consisting of undifferentiated fecal debris and inseparable fines, is present in 85 percent of AH coprolites, 100 percent of IH samples and 100 percent of GC specimens. Much of this category is very fine, probably milled, vegetal matter, such as cornmeal. Debris is often a major portion of the specimen weight and, like grit, may tend to skew analysis.

Major Meal Components

Identified plant components from Antelope House coprolites are compared by period, room block and room number in Table 66 and are discussed below. Major components are those accounting for more than 1 percent by weight. Also considered here are generalized plant remains (epidermis, fiber and stem), bone fragments (representing meat intake) and debris (indicating the degree of food preparation by milling).

Pueblo I.

The Pueblo I level yielded a single coprolite, so that little can be said about Pueblo I diet. Three identified components are present. Of these, the most important is corn (51 percent), supplemented by squash seed (12 percent). Purslane seed is present in miniscule quantity. A high percentage weight of grit (12.5 percent) may indicate a high intake of milled food and appears to correlate with the high percentage of corn and debris (19 percent).

Pueblo II.

Fifteen coprolites were recovered from Pueblo II levels in three structures. These contain 14 identified components—amaranth seed, beeweed seed, cactus epidermis/spine, corn, cotton seed, goosefoot seed, grape seed, ground cherry seed, panic grass seed, pine nut shell fragments, prickly pear seed (representing ingestion of fruit), squash seed, sunflower seed and yucca seed. Of these, six are major components (Table 72).Corn is the most important dietary constituent.

Early Pueblo III.

Six coprolites were recovered from EPIII levels in two structures. These contain six identified components: beeweed seed, cactus epidermis/spine, corn, ground cherry seed, purslane seed and squash seed. Two of these are major components. Corn is the most important dietary constituent and is a major component in all samples. Average percentage of coprolite weight is 56.23; range is 27.30 percent to 78.98 percent. Cactus is present in three specimens and is a major component of two. Average percentage of coprolite weight is 2.37; range is 0.54 percent to 4.69 percent. General plant remains are present in all samples and are a major component of five. Average percentage of coprolite weight is 2; range is .07 percent to 4.09 percent. Unidentified bone fragments are present in three specimens and are a major component of one. Average percentage of coprolite weight is .74; range is .09 percent to 1.99 percent. What appear to be bird bones are present in one sample, accounting for 6.74 percent of its weight. Debris is present in five samples and is a major component of four. Average percentage of coprolite weight is 21.46; range is .12 percent to 48.74 percent.

Middle Pueblo III.

The MPIII level yielded only one specimen, which contained three identified components; amaranth seed, corn and saltbush leaf fragments. Of these, two were major components. Corn is the most important component and accounts for

Table 72. Major components of Pueblo II coprolites.
(Numbers in parenthesis represent number of specimens in which item is present and number in which it is a major component, respectively.)

Component	*Avg. % of Coprolite Wt.*	*Min. % of Coprolite Wt.*	*Max. % of Coprolite Wt.*
corn (15;14)	39.65	.12	78.16
cactus epidermis/spines (3;2)	2.40	.01	13.5
ground cherry seeds (7;2)	.99	.10	2.00
pine nuts (10;8)	8.73	.16	22.29
prickly pear seeds (4;4)	17.41	2.17	56.14
squash seeds (10;8)	2.75	.37	6.33
general plant remains (15;14)	2.37	.76	8.35
bone fragments (9;2)	1.76	.14	10.65
debris (15;14)	21.87	.21	95.88

Table 73. Major components of Late Pueblo III coprolites, South Room Block.
(Numbers in parenthesis represent number of specimens in which item is present and number in which it is a major component, respectively.)

Component	*Avg. % of Coprolite Wt.*	*Min. % of Coprolite Wt.*	*Max. % of Coprolite Wt.*
corn (38;38)	44.01	1.46	97.57
amaranth seed (6;1)	.62	.01	2.00
cactus epidermis/spine (17;12)	8.88	.06	82.12
beeweed seed (6;2)	3.75	.15	20.07
squash epidermis/seed (8;5)	3.90	.15	10.57
horsebrush stem (4;3)	3.57	.88	6.05
cotton seed (10;8)	10.80	.27	27.71
pepper grass seed (1;1)	62.12 of specimen wt.		
prickly pear seed (5;5)	35.71	1.72	76.66
Indian rice grass seed (3;1)	17.91	.23	52.95
bean epidermis (1)	6.11 of specimen wt.		
pine nuts (11;10)	20.83	.46	71.00
purslane seed (4;1)	.57	.07	1.88
squawbush seed (6;6)	8.10	1.41	22.02
grape seed (1)	2.40 of specimen wt.		
general plant remains (41;35)	3.43	.03	15.64
bone fragments (14;9)	3.95	.05	21.97
debris (33;32)	30.35	.61	94.06

22.7 percent of the sample's weight. Saltbush leaf fragments account for 6.25 percent of its weight, general plant remains .59 percent, bone fragments 2.32 percent and debris 67.39 percent.

Late Pueblo III.

The South Room Block yielded 42 specimens from three structures at the LPIII level. These contained 21 identified components: amaranth seed, bean epidermis, beeweed seed, cactus epidermis/spine, corn, cotton seed, dropseed seed, goosefoot seed, grape seed, grass seed, ground cherry seed, horsebrush stem, Indian rice grass seed, pepper grass seed, pine nut fragments, prickly pear seed, purslane seed, squash epidermis/seed, squawbush seed, sunflower seed and wild rye. Of these, 15 are major components (Table 73). Corn is the most important dietary constituent. The large size of the single grape seed recovered distorts its importance in the diet.

Table 74. Major components of Late Pueblo III coprolites, Central Room Block. (Numbers in parenthesis represent number of specimens in which item is present and number in which it is a major component, respectively.)

Component	*Avg. % of Coprolite Wt.*	*Min. % of Coprolite Wt.*	*Max. % of Coprolite Wt.*
corn (15;15)	30.33	1.06	92.09
cactus epidermis/spines (7;3)	9.73	.04	61.55
beeweed seed (2;2)	2.01	1.70	2.32
squash epidermis/seeds (5;3)	2.55	.02	8.38
horsebrush stems (2;2)	5.04	1.01	9.06
cotton seeds (3;2)	9.22	.55	22.54
prickly pear seeds (2;1)	1.60	.30	2.90
ground cherry seeds (3;2)	8.03	.27	12.42
pine nuts (5;1)	2.56	.21	11.32
purslane seeds (3;2)	2.35	.14	5.63
dropseed seeds (1;1)	4.21 of specimen wt.		
general plant remains (17;14)	10.40	.53	61.17
bone fragments (2;2)	14.22	11.62	16.81
debris (14;14)	41.48	3.33	81.62

Table 75. Major components of Late Pueblo III coprolites, North Room Block. (Numbers in parenthesis represent number of specimens in which item is present and number in which it is a major component, respectively.)

Component	*Ave. % of Coprolite Wt.*	*Min. % of Coprolite Wt.*	*Max. % of Coprolite Wt.*
corn (8;7)	35.07	.38	85.68
onion epidermis (2;1)	.69	.01	1.36
cactus epidermis/spines (4;3)	2.60	0.6	5.37
beeweed seeds (2;2)	35.51	32.04	36.62
horsebrush stems (1;1)	15.00 of specimen wt.		
cotton seed (2;1)	1.39	.95	1.82
general plant remains (8;6)	3.79	.16	12.10
debris (6;6)	56.23	5.71	85.88

The Central Room Block at the LPIII level yielded 17 specimens from six structures. These contain 13 identified components: amaranth seed, beeweed seed, cactus epidermis/spine, corn, cotton seed, dropseed seed, goosefoot seed, ground cherry seed, horsebrush stem, pine nut fragments, prickly pear seed, purslane seed and squash epidermis/seed. Of these 11 are major components (Table 74). The major dietary constituent is corn.

The North Room Block at the LPIII level yielded eight coprolites from six structures. These contain seven identified components: beeweed seed, cactus epidermis/spine, corn, cotton, horsebrush stem, onion epidermis and squash seed. Of these, six are major components (Table 75). Corn is the most important dietary constituent. Bone fragments were found in two samples, but are major components of neither.

Navajo.

A single coprolite is dated to the Navajo occupation. It contains four identified plant varieties: amaranth seed, cactus epidermis/spine, corn and goosefoot seed. None of these are major components. The most important dietary component is bone fragments (meat?), forming 8.33 percent by weight. The sample is not markedly different from many other specimens.

Significance of Dietary Items

Of 25 identified plant components, 17 are present in one or more coprolites in weights sufficient to demonstrate that they were significant dietary items. The most important dietary item obviously is corn, which is to be expected. However, many items which ordinarily are minor components are occasionally present in high weights, indicating that they formed a major portion of particular meals. A few examples illustrate this. Sample 3, Room 21, LPIII, contains 2 percent amaranth seed. Bean epidermis is 6.1 percent of Sample 27, Room 29, LPIII. Sample 92, Room 18, LPIII, contains 36.6 percent beeweed seed. Cactus epidermis is 59 percent of Sample 90, Room 81, LPIII. Four samples contain more than 20 percent cotton seed; Sample 71, Room 21, LPIII, contains 27.7 percent cotton seed. Dropseed seed is 4.2 percent of Sample 55, room 42, LPIII. Sample 61, Room 42, LPIII, contains 12.4 percent ground cherry seed. Horsebrush stem is 15 percent of Sample 91, Room 5, LPIII. Indian rice grass seed is 53 percent of Sample 6, Room 21, LPIII. Sample 10, Room 21, LPIII, contains 62.1 percent pepper grass seed. Sample 69, Room 21, LPIII, contains 71 percent pine nut shell fragments. Several samples contain at least 70 percent prickly pear seed; Sample 5, Room 21, LPIII, contains 76.7 percent prickly pear seed. Purslane seed is 5.6 percent of Sample 61, Room 42, LPIII. Saltbush leaf fragments are 6.3 percent of Sample 78, Room 82, MPIII. Squash seeds and tissue are major components of many specimens; Sample 48, Structure 74, PI, contains 12 percent squash seed and Sample 59, Room 42, LPIII, contains 8.4 percent squash epidermis. Squawbush seed is 22 percent of Sample 27, Room 29, LPIII.

The most obvious characteristic of Antelope House meals revealed by this analysis is the importance of cultigens and cultivars in the diet. For purposes of this discussion, cultigens are considered those plants dependant upon human manipulation for survival, while cultivars are cultivated or manipulated by human beings, but are not dependent upon them for survival (see Jennings 1974: 194).

Domesticated corn is present in 84 samples (92 percent), very often in high percentage weights. Squash seed is second in importance among cultigens and is present in 26 specimens (29 percent). Surprisingly, cotton seed is third among cultigens and is present in 16 samples (18 percent). The other domesticated plant residue present in these coprolites is bean epidermis, which is present in only one specimen. As noted earlier, bean parts may be destroyed in the digestive process.

Among cultivars, cactus epidermis (probably prickly pear epidermis, representing ingestion of pads) is present in 39 specimens (43 percent). Amaranth seed is present in 11 specimens (12 percent), usually as a minor constituent. Prickly pear seed, representing ingestion of the fruit, is present in 11 samples (12 percent). Beeweed seed is present in 14 specimens (15 percent). Sunflower seeds are present in four specimens (4 percent).

The most noticeable change through time is an increase in the number of components in Late Pueblo III. Of our 25 identified plant components, only three are absent in LPIII times: panic grass seed, saltbush leaf and yucca seed/pod. None of these is considered a major meal component and their absence does not appear to be significant. The apparent increase in dietary complexity may be due to a simple sample error, since 51 samples (56 percent) of a total 91 are from three LPIII rooms. Twenty-four coprolites are from Room 21, 15 are from Room 29, and 12 are from Room 42. All identified components, except amaranth seed, onion epidermis, panic grass seed and yucca seed/pods, are from one or more of these rooms. Present only in Room 21 are amaranth seed, grape seed, grass seed, Indian rice grass seed and pepper grass seed. Bean epidermis and wild rye seed are present only in Room 29, while ground cherry seed and horsebrush stem are absent. In Room 42, squawbush seed and sunflower seed are absent.

Present only in LPIII coprolites are bean epidermis, dropseed seed, grass seed, Indian rice grass seed, horsebrush stem, onion epidermis, pepper grass seed, squawbush seed and wild rye seed. Of these, bean epidermis, dropseed seed, Indian rice grass seed, horsebrush stem, onion epidermis, pepper grass seed and squawbush seed are present in percentage weights large enough to be considered major meal components; if the increase in dietary complexity is due to more than simple sample error, these may be indicators.

In general, there is little in the coprolite evidence to indicate a major adaptational change at

any time in the occupation of Antelope House. It appears that corn was the primary dietary item, supplemented by three domesticated plants, three cultivars, at least 18 wild plant foods, meat, and, occasionally, grasshoppers.

Behavioral Inferences

Food preparation techniques are indicated by coprolites, as noted in the discussion of coprolite components. The abundance of whole and fragmentary kernels of corn with tiny pieces of cob attached indicate that this food item was often eaten whole, when green or when ripe. The presence of tiny fragments of charcoal in 81 percent of the samples indicates the common practice of cooking by roasting, parching, etc. The presence of grit in 77 percent of the samples (primarily as milling detritus) attests to the practice of milling.

Tiny charred bone fragments indicate consumption of bone cakes and/or the eating of meat. Other charred bits indicate that cactus pads were prepared for eating by first burning off the spines. Cactus fruits were eaten whole, as evidenced by the presence of whole, unburned seeds in coprolites. High percentages of undifferentiated fecal debris is indicative of meals consisting of large amounts of milled foods, such as corn meal.

Seasonality may be indicated by some foods. Corn eaten off the cob, for instance, points to ingestion from spring to fall. Grasshoppers are active in the warm months between April and October. Many foods, however, are not indicative of seasonality. Opuntia fruits may be stored for several months, while pine nuts and the numerous hard-shelled seeds maturing in late summer and early fall may be kept for winter or early spring consumption by storing them in pots or cysts.

Human hair in coprolites may indicate grooming behavior, since a human hair with an attached egg case of a louse (*Pediculus humanus*) was found in a human coprolite from Danger Cave, while an Anasazi coprolite from Glen Canyon contained the body of a louse (Fry 1970a: 88).

Parasites

The only human parasite positively identified in the coprolites is the ubiquitous, exclusively human-oriented pinworm, *Enterobius vermicularis*. Its presence adds credence to the belief that the samples are of human origin. Specimens containing *E. vermicularis* are listed in Table 76. Since Rooms 21 and 29 have the greatest numbers of analyzed coprolites (33 and 20, respectively), the distribution of parasites may be due to sample selection. Ova of this nematode (roundworm) species are present in 14 of 91 coprolites (15.4 percent), indicating a probable high rate of infection at Antelope House; direct examination of modern stools shows less than 5 percent of the true infection rate (Chandler and Reed 1965).

E. vermicularis invades the cecum, the appendix and neighboring regions of the intestines. Gravid females migrate down the bowel and out of the anus onto the perianal region, where the ova are laid. The movements of worms in this area cause mild to severe pruritis (itching). In female hosts, the parasites sometimes reach the vulva and move up the genital tract, causing vaginitis. Worms in all stages of development are found in the appendix and are strongly suspected by some of causing appendicitis. Many authorities, however, disregard this view, noting that worms are found in normal, as well as in inflamed, appendices (Chandler and Read 1961: 463). By far, the most common sympton of enterobiasis is severe *pruritis ani*. When the host scratches the anal region, scarification, weeping exczema or other secondary infections can de-

Table 76. Coprolites positive for *Enterobius vermicularis*

Specimen No.	*Room Block*	*Room No.*	*Time Period*
10	South	21	LPIII
11	South	21	LPIII
12	South	21	LPIII
22	South	29	LPIII
23	South	29	LPIII
28	South	29	EPIII
44	South	21	PII
64	South	21	LPIII
67	South	21	LPIII
70	South	21	LPIII
71	South	21	LPIII
74	North	19	LPIII
87	North	47	LPIII
88	North	N. Trench	LPIII
—			
14 Total			

velop. The most common complaints, however, are behavioral, with symptoms of insomnia, nervousness, restlessness or, occasionally, sexual disorders. Thus, it is doubtful that community health at Antelope House was severely affected by *E. vermicularis*.

The cause of high rates of pinworm infestation in prehistoric and modern populations is due to human sanitation practices. Scratching of the egg-laden anal region transports ova via the fingernails directly to the mouth or indirectly via food prepared by uncleansed hands. Further, the ova are extremely light and float about in the air around contaminated bedding, clothing, etc., and are inhaled or fall as dust, which is later stirred up and the ova inhaled. In short, the eggs are disseminated throughout human living areas; the smaller the enclosed space, the greater the concentration of eggs (Schiffner 1944). In view of the small rooms at Antelope House, it would have been difficult for the majority of people to have escaped constant reinfection in the course of normal living.

The discovery of pinworm ova in coprolites from Antelope House is not surprising. This parasite has been identified at five other New World sites, all situated in the arid west of North America (Fry and Moore 1969; Samuels 1965; Fry 1970; Hall 1972; Fry and Hall 1973). Fry and Moore (1969) report infestations at Danger Cave and Hogup Cave, Utah, as early as 8000 BC.

Mites (Acarina)

Twelve coprolites contain larvae and ova of several as yet unidentified species of Acarids (Table 77). One specimen (AH76) probably is the larval stage of the genus *Trombicula*, commonly called redbugs or chiggers (Chandler and Read 1965). Eggs of these mites are laid on the ground and lower parts of grasses and bushes. At maturity, a 6-legged larva (as found in the coprolite) emerges and may attach to any terrestrial vertebrate, including man. The larval mite pierces the skin and sucks the tissue juice until, engorged, it drops to the ground, where it passes through two metamorphoses before adulthood (Faust *et al.* 1968: 335). During the time of attachment, the mite may cause damage to man in the form of dermatitis. Some people develop a severe local reaction, due to sensitization to injected mite saliva. A wheal may form and bleeding may result. Despite these symptoms, even those most sensitive to the mite become immunized after a few bites (Chandler and Read 1965). Thus it would appear that human health at Antelope House would not have been greatly affected. Other mites probably are free-living varieties and would not have posed a health problem.

Eight coprolites contain probably free-living rhaditid nematode larvae (Table 77), which would not have affected community health. Nematode larvae are commonly found in coprolites (Dusseau and Porter 1974; Fry 1970; Hall 1972; Heizer and Napton 1969).

Summary and Conclusions

1. Ninety-one coprolites from Antelope House were analyzed for diet and parasites. The specimens are from 21 structures and six temporal periods, ranging from Pueblo I through Navajo.

Table 77. Coprolites positive for mites/ova and nematode larvae.

Mites and Ova:

Specimen No.	*Room Block*	*Room No.*	*Time Period*
13	South	21	LPIII
21	South	29	LPIII
24	South	29	LPIII
25	South	29	EPIII
37	South	21	PII
38	South	21	PII
46	South	21	PII
48	South	74	PI
52	South	73	PII
66	South	21	LPIII
76	North	35	PIII
79	Central	33	LPIII
—			
12 Total			

Nematode Larvae:

Specimen No.	*Room Block*	*Room No.*	*Time Period*
18	South	29	LPIII
19	South	29	LPIII
21	South	29	LPIII
24	South	29	LPIII
33	South	29	LPIII
41	South	21	PII
49	South	73	PII
88	North	N. Trench	LPIII
—			
8 Total			

The majority of specimens are from the LPIII levels of Rooms 21, 29 and 42.

2. Twenty-five identified plant taxa have been recovered to date. Four taxa are cultigens (beans, corn, cotton and squash), five are cultivars (amaranth, beeweed, cactus, prickly pear and sunflower) and 16 are wild species (dropseed seed, goosefoot seed, wild grape, grass family seed, ground cherry seed, horsebrush stem, Indian rice grass seed, wild onion, panic grass seed, pepper grass seed, pine nut shell fragments, purslane seed, saltbush leaves, squawbush seed, wild rye seed and yucca seed and pod fragments).

3. Additional coprolite components include five varieties of unidentified seeds, plant epidermis, fibre and stem, bone fragments (representing ingestion of meat or bone cakes), charcoal (probably debris from the parching process), feathers (primarily turkey), grit (including milling stone detritus), unidentified animal hairs, human hair, coprophageous insect parts, grasshopper parts, sinew (ingestion of meat?), a piece of string and undifferentiated fecal debris (much of which is finely ground corn).

4. The most important dietary item is corn, supplemented by a wide variety of cultigens, cultivars, wild plants, meat and occasional grasshoppers.

5. Behavioral factors are indicated by dietary components. Charcoal probably indicates preparation of small seeds by parching or roasting of foods. Grit probably indicates milling of small seeds, as does the large percentages of fine debris. Abundant whole and fragmentary corn kernels, often attached to pieces of cob, indicate that corn often was eaten green or off the cob. Consumption of meat and/or bone cakes is indicated by bone fragments, animal hairs and tiny feathers. The presence of grasshopper parts indicates insect consumption. Human hair in coprolites may indicate grooming behavior.

6. Room 21 diets are more complex than those of other rooms in the same and other room blocks, especially in LPIII times.

7. An increase in dietary complexity seems to occur in LPIII times, although this finding may be due to sample error.

8. The human population was parasitized by the pinworm *Enterobius vermicularis*, probably with little effect on community health.

9. Coprolites contain free-living nematodes, mites and their ova. One specimen contained a larval redbug mite (*Trombicula*).

10. There is little indication in the coprolite evidence of dietary change, no indication of a major shift in adaptive strategy and no evidence of any major pathological organisms.

Chapter 15

Pollen Analysis of Human Coprolites

Investigation of prehistoric human feces (coprolites) has been discussed in archeological literature since the early 20th century, as in Young's (1910: 324) remarks on fecal material recovered from Salt's Cave, Kentucky. Such early investigations characteristically consisted of gross observation of the bits of vegetal and animal matter which survived the crushing, screening or breaking open of the coprolite. The utility of rehydrating dried tissues demonstrated by Van Cleave and Ross (1947) and Benninghoff (1947), and the subsequent refinement of the trisodium phosphate technique by Callen and Cameron (1955, 1960) revolutionized coprolite studies. Using the rehydration method, investigators can examine fecal constituents without causing the damage to delicate tissues that results from the dry separation process.

While the potential results of coprolite analysis were expanded by the application of the tir-sodium phosphate method, investigators still were considering only the macrofossil portion of the fecal residue. It was not until Martin and Sharrock (1964) published their analyses of the microfossil, or pollen, portion of coprolites from Glenn Canyon that this other, invisible side of human fecal residue was recognized. The importance of the microfossil fraction was illustrated by Callen and Martin (1969) in their analysis of other Glenn Canyon coprolites. In that study, the ingestion of *Cleome* (beeweed) flowers was evidenced only by the presence of pollen; if the pollen fraction had not been analyzed, the dietary use of this plant would not have been suspected, as the report makes clear.

Since 1964, several pollen analyses of coprolites have been made, including studies by Napton and Kelso (1969), Riskind (1970) and Williams-Dean Bryant (1975). These analyses have largely ignored the macrofossil portions of their respective coprolites for one reason or another, however, and diet can be determined only by study of both the macrofossil and microfossil fractions. The macrofossil portion will contain vegetal and animal remains that may not be represented in the pollen portion; the microfossil portion will contain pollen that may identify some otherwise unidentifiable fibrous remains or provide unexpected dietary evidence. Bryant (1969, 1974a, 1974b, 1975) has conducted pollen analyses of coprolites in which he also considered the macrofossil portions of the specimens. The analysis reported here follows his example. In this regard, I acknowledge the kindness of Dr. Gary Fry in allowing access to the data he collected from the macrofossil portions of the Antelope House coprolites (see Chapter 14).

As part of an expanded study of the co-

prolites, 92 samples were sent to the Texas A&M University Anthropology Laboratory for palynological studies in 1974. Preliminary results from 46 of those samples have been reported (Williams-Dean 1975; Williams-Dean and Bryant 1975). The pollen investigations of all 92 coprolite samples, as well as that of 11 surface soil samples from various canyon locations around Antelope House, are reported here.

My analysis had the following goals:

1. Identification of the anemophilous (wind dispersed) and zoophilous (insect dispersed) pollen types from the 11 surface soil samples, which were used to provide an environmental backdrop for the interpretation of the culturally influenced contents of the coprolites themselves;

2. Identification of the anemophilous and zoophilous pollen types from the 92 coprolite samples, enabling me to compile a floral inventory of pollen-bearing plants or plant parts which could have been deliberately ingested;

3. Separation of culturally ingested pollen types from incidentally ingested background pollen types on the combined bases of percentages of total pollen and analogies with ethnographic records for the area (Bryant 1974b);

4. Demonstration of changes in dietary preferences over time, if possible, by comparison of the pollen profiles of the coprolites from the various cultural periods;

5. Determination of the season of defecation for each coprolite, if possible, by utilization of the blooming seasons of the incidentally ingested pollen types, as well as the blooming seasons for those deliberately ingested pollen types having no ethnographic record of storage.

Extraction and Analysis

Each of the 92 coprolite fragments was placed in a 0.5 percent solution of trisodium phosphate, after Callen and Cameron (1960), and allowed to reconstitute completely before being agitated to break it down as much as possible before screening. The samples then were washed with ethanol through a brass screen having a mesh of 150 microns to separate the pollen from the larger debris. The macrofossils remaining on top of the screen were dried on filter paper and saved. The liquid fine fraction collected below the screen contained pollen and other extraneous material, which was chemically processed. Cold hydrofluoric acid was used to remove silicates; acetolysis with a mixture of nine parts acetic acid anhydride and one part concentrated sulfuric acid (after Erdtman 1960) removed nonpolleniferous organic matter. The pollen residue was dehydrated and stained in an alcohol and benzene series and finally was mixed with 2,000 CKS silicon oil in storage vials.

The 11 surface samples initially were treated with hydrochloric acid to remove carbonates, followed by density separation with zinc chloride of 2.0 specific gravity to remove siliceous debris. Acetolysis and a final screening through a 150-micron mesh brass screen preceded staining and storage as above.

Individual microscope slides were made of all samples after thoroughly mixing the contents of each vial with silicon oil. A statistically valid 200 grain count, as recommended by Barkley (1934) and Martin (1963), was attempted for each specimen. Pollen identifications were made with the aid of the Texas A&M University Modern Pollen Reference Collection and published reference works. Of the 92 coprolite samples analyzed, 85 contained at least 200 pollen grains. The remaining seven samples (numbers 8, 16, 22, 36, 38, 39 and 44) contained less than 200 pollen grains, and their pollen frequencies will not be considered in the following discussions. Badly deteriorated grains were not counted and unidentifiable grains were counted as unknowns. Spores in the coprolites were not identified or counted, as several samples had developed fungal growths during the reconstitution process. Some of the spores, however, could have resulted from deliberate ingestion. The Zuni, for example, gathered and consumed fresh puffballs (*Lycoperdon*) in large quantities and dried these spore-producing structures for winter use (Stevenson 1915: 69). While they probably were not eaten after the inner tissue had produced spores, puffballs conceivably could be represented in coprolites by spores formed and eaten while the larger part of the puffball still was fleshly. The Zuni and the Hopi also used corn smut (*Ustilago*) as a food and medicine. The Hopi (Whiting 1939: 100) cooked corn smut with sweet corn as a food and the black pores were used as a ceremonial body paint. The Zuni (Stevenson 1915: 61–62) administered sips of water mixed with a pinch of the spores to hasten childbirth and to stop hemorrhaging after birth.

Problems of Coprolite Analysis

A human coprolite is the most direct evidence of dietary habits, individual health and possibly of seasonality of site occupation to which the archeologist has access. The nature of the data, however, presents certain problems.

The rate of fecal formation and discharge is not the same for all individuals; it is affected by factors such as diet composition and health. A desiccated coprolite recovered archeologically and catalogued as a single specimen may actually constitute the remains of more than one meal due to the constipation of its originator. By the same token, several coprolites deposited individually because of diarrhea may actually result from a single meal. In both cases, the data recovered would not greatly affect a reconstruction of general diet, but would skew a reconstruction of individual meal components, as well as population estimates based on the number of fecal specimens.

Amounts of excrement formed also are highly variable, depending on the makeup of the diet. For example, an adult male on a mixed diet will daily excrete an average of 110 to 170 grams of moist feces (solid content of from 25 to 45 grams); the same individual on a vegetable diet may daily excrete as much as 350 grams of moist feces (solid content of 75 grams) (Oser 1964: 530). Heizer (1969: 248) speaks of the well-formed Lovelock Cave coprolites as being as much as 3 inches in diameter, resulting from a coarse vegetable diet. Bryant (1974b: 412) describes coprolites from southwest Texas as being flat and amorphous. Such loose feces could have resulted from the eating of plants with laxative qualities or from the drinking of stagnant water containing diarrhea toxin-producing algae (Aziz 1974). Small amounts of feces (7 to 8 grams) are excreted daily even when no food is ingested (Oser 1965: 535). Thus the size and shape of coprolites could, but need not, reflect differing states of health. Available dietary options must also be considered.

Another problem associated with the analysis of coprolites is the quantification of data. Calculating pollen types as percentages of a total has a coefficient of reliability of .90 when about 200 grains are counted per sample (Barkley 1934). Few new pollen types are seen until as many as 400 grains have been counted (Martin 1963: 30–31). The standard against which the presences of the various pollen types are compared is the 200 ± pollen grain total. It must be remembered that the figures for pollen presences represent the percentages of the pollen *portion* of a coprolite, not the percentage of the makeup of a coprolite. A coprolite composed of appreciable amounts of pollen is almost inconceivable.

Interpretation of the manner in which the materials found in coprolites were introduced into the human body presents another problem. Were the materials eaten as food or swallowed accidentally? Do they represent a ceremonial or medicinal activity? Directions for interpreting such materials, be they pollen or plant or animal macrofossils, are suggested by ethnographic data collected in historic times from native groups inhabiting the area under study or another area of similar climate and vegetational environment. Although such ethnographies may be of a group identical to or with known ties to the group under study, as among many extant Southwestern groups, it is more often the case that the group under study is extinct, and can be related to others only through analogy. These analogies, as Ascher (1961: 319) notes, should be sought "in cultures which manipulate similar environments in similar ways."

In the present paper, I have used ethnographies for the Zuni, Tewa, Hopi, Navajo, Havasupai, Mohave, Yuma, Cocopa, Maricopa, Pima, Papago, and, in certain instances, the Mescalero and Chiricahua Apache as sources for ideas in interpretation of the pollen data. These groups, diverse in time and space, were chosen primarily because they inhabit or inhabited environments similar to that at Antelope House and with roughly comparable technologies. The wisdom of that choice was demonstrated by the many analogies which could be drawn to account for the appearance of pollen grains in various amounts in the Antelope House coprolites. My use of Navajo ethnographic data is supported by the numerous similarities between their uses of the environment compared with their neighbors, despite the original cultural distinctness of the immigrant Navajo. In short, the many similarities between these groups in their use of specific plants and the degree to which those similar uses seem to explain the Antelope House pollen data indicate to me that the ethnographic data should at least be presented as plausible suggestions for the patterns seen in the Antelope House co-

prolites, despite other cultural differences between the groups. In no instance do I mean to say that a given plant was ingested in a specific manner in the past.

Results

Thirty-eight types of arboreal and non-arboreal pollen were identified from the Antelope House samples and are divided into non-economic (background) and economic categories. Background pollen types commonly are anemophilous (wind dispersed) and, as such, make up the pollen rain which constantly falls to the ground. The occurrence of anemophilous pollen in feces usually results from the inhalation of airborne pollen at the time of its initial dispersal or from drinking water or eating food onto which the pollen has settled (Bryant 1974b). Thus, ane-

Table 78. Percentages of background pollen from coprolite samples (x indicates presence in pollen-deficient samples).

Sample No. Tamu/Fry	Room No.	*Pinus*	*Quercus*	*Alnus*	*Juglans*	*Celtis*	*Ulmus*	*Artemisia*	*Sarcobatus*	*Ephedra*	*Gramineae*	*Urticaceae*	*Cyperaceae*	*Salix*	*Sphaeralcea*	*Eriogonum*	*Rhus*	*Polygonum*	*Ribes*	*Umbelliferae*	*Malvaceae*	*Caryophyllaceae*	*Nyctaginaceae*	*Onagraceae*
1	11	21	0.5	0.5	–	–	–	–	1.0	–	–	7.5	–	–	–	–	–	–	–	–	–	–	–	–	–
2	14	21	11.0	2.0	–	–	–	–	–	–	1.0	1.0	–	–	–	–	–	–	–	–	0.5	–	–	–	–
3	13	21	5.0	–	–	–	–	–	3.0	–	–	2.0	–	–	–	–	–	–	–	–	–	–	–	–	–
4	16	21	1.0	–	–	–	–	–	–	–	–	3.0	–	–	–	–	–	–	–	–	–	–	–	–	–
5	9	21	3.0	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6	67	21	0.5	0.5	–	–	–	–	–	–	–	3.0	–	–	–	–	–	–	–	–	0.5	–	–	–	–
7	3	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
8	7	21	x	x	–	–	–	–	x	–	x	x	–	–	–	–	–	–	–	–	x	–	–	–	–
9	70	21	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.5	–	–	–	–	–
10	5	21	2.0	–	–	–	–	–	0.5	–	–	2.0	–	–	–	–	–	–	–	–	–	–	–	–	–
11	66	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
12	4	21	1.0	–	–	–	–	–	1.0	0.5	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–
13	15	21	–	–	–	–	–	–	–	–	–	1.0	–	–	–	–	–	–	–	2.0	1.0	–	–	–	–
14	64	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
15	6	21	0.5	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16	2	21	x	–	–	–	–	–	x	–	x	x	–	–	–	–	–	–	–	–	x	–	–	–	–
17	1	21	0.5	–	–	–	–	–	–	–	0.5	22.5	–	–	0.5	–	–	–	–	–	0.5	–	–	–	–
18	69	21	1.5	–	–	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	2.0	–	–	–	–
19	10	21	2.0	1.0	–	–	–	–	2.5	–	–	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–
20	12	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21	8	21	–	–	–	–	–	–	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
22	71	21	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23	65	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
24	68	21	0.5	0.5	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
25	89	45	9.5	1.0	–	–	–	–	1.0	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–
26	74	19	0.5	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
27	19	29	5.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
28	27	29	1.0	0.5	–	–	–	–	2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
29	52	73	1.0	–	–	–	–	–	5.0	–	–	6.5	–	–	–	–	–	–	–	–	–	–	–	–	–
30	31	29	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.0	–	–	–	–	–
31	48	74	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
32	79	33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
33	35	29	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
34	73	18	3.0	1.0	–	–	–	–	2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
35	59	42	3.0	–	–	0.5	–	–	15.5	0.5	–	2.0	–	–	–	–	–	–	–	1.0	0.5	–	–	–	–
36	76	35	x	x	–	–	–	x	x	–	–	x	–	–	–	x	–	–	–	–	–	–	–	–	–
37	90	81	4.5	0.5	0.5	–	–	–	16.5	–	–	3.5	1.0	–	–	–	–	–	–	–	–	–	–	–	–
38	85	KivaD	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
39	80	23	x	–	–	–	–	–	x	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–

continued

Table 78. Percentages of background pollen from coprolite samples (x indicates presence in pollen-deficient samples)—Continued

Sample No. Tamu/Fry		Room No.	*Pinus*	*Quercus*	*Alnus*	*Juglans*	*Celtis*	*Ulmus*	*Artemisia*	*Sarcobatus*	*Ephedra*	*Gramineae*	*Urticaceae*	*Cyperaceae*	*Salix*	*Sphaeralcea*	*Eriogonum*	*Rhus*	*Polygonum*	*Ribes*	*Umbelliferae*	*Malvaceae*	*Caryophyllaceae*	*Nyctaginaceae*	*Onagraceae*
40	83	77	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
41	51	73	4.0	–	–	–	–	–	–	–	–	2.0	–	–	–	–	–	–	–	–	–	1.0	–	–	–
42	87	47	11.0	2.0	–	–	–	–	10.0	0.5	–	19.0	–	–	–	–	–	–	–	–	0.5	–	–	–	–
43	88	N251	4.0	0.5	–	–	–	0.5	5.0	–	–	10.0	–	–	–	–	–	–	–	–	–	–	–	–	–
44	84	35	x	x	–	–	–	x	x	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–
45	72	23	6.5	0.5	–	–	0.5	–	0.5	–	0.5	0.5	–	–	5.0	–	–	–	–	–	0.5	0.5	–	–	–
46	75	89	1.5	–	–	–	–	–	0.5	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–
47	56	42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
48	34	29	6.0	1.0	–	–	–	–	1.0	–	–	3.0	–	–	1.0	–	–	–	–	–	–	–	–	–	–
49	77	26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
50	62	42	7.0	–	–	–	–	–	2.0	–	1.0	4.0	–	–	–	–	–	–	–	–	–	–	–	–	–
51	25	29	1.0	–	–	–	–	–	0.5	–	–	–	–	0.5	–	–	–	–	–	–	0.5	–	0.5	–	–
52	86	23	5.0	2.0	–	0.5	–	–	5.0	0.5	–	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–
53	41	21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.5	–	–	–	–
54	90	81	1.0	–	–	–	–	0.5	20.0	–	–	4.0	–	–	2.0	–	0.5	–	–	1.0	0.5	–	–	–	–
55	61	42	1.0	0.5	–	–	–	–	1.0	–	–	3.0	–	–	0.5	–	–	–	–	–	–	–	–	–	–
56	18	29	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
57	28	29	0.5	–	–	–	–	0.5	0.5	–	–	–	–	0.5	–	–	–	–	–	–	1.0	–	–	–	–
58	60	42	0.5	–	–	–	–	–	–	–	–	0.5	–	–	1.0	–	–	–	–	–	1.0	–	–	–	–
59	32	29	5.0	–	–	–	–	–	4.0	–	2.0	6.0	–	–	2.0	–	–	0.5	–	–	–	–	–	–	–
60	36	29	3.0	1.0	–	–	–	–	3.0	–	–	3.0	–	–	2.0	–	–	–	–	–	1.0	–	–	–	–
61	20	29	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
62	21	29	0.5	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	1.0	–	–	–
63	54	42	0.5	–	–	–	–	–	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–
64	22	29	1.0	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
65	82	42	3.0	1.0	–	–	1.0	–	1.0	–	0.5	2.0	–	–	2.0	–	–	–	–	–	1.0	–	–	–	–
66	55	42	1.0	–	–	–	–	–	–	–	–	26.0	–	–	0.5	–	–	–	–	–	–	–	–	–	–
67	63	42	5.0	7.0	–	–	–	–	7.0	–	0.5	3.0	–	–	0.5	–	0.5	–	–	–	–	–	–	–	–
68	29	29	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
69	37	21	–	–	–	–	–	–	0.5	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–
70	58	42	–	–	–	–	–	–	–	–	–	1.0	–	–	–	–	–	–	–	–	–	–	–	–	–
71	30	29	0.5	–	–	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–
72	38	21	–	–	–	–	–	–	1.0	–	–	–	–	–	–	–	–	–	–	–	1.0	–	–	–	–
73	49	73	6.0	0.5	–	–	–	–	2.0	–	–	5.0	–	–	–	–	–	–	–	–	0.5	–	–	–	–
74	17	29	13.0	2.0	–	–	–	–	5.0	–	0.5	3.0	–	2.0	1.0	0.5	–	–	–	–	–	–	–	–	1.0
75	39	21	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
76	78	82	2.0	0.5	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
77	44	21	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
78	57	42	2.0	0.5	–	–	–	–	0.5	–	0.5	26.5	–	–	2.0	–	–	–	–	–	–	–	–	–	–
79	42	21	0.5	–	–	–	–	–	0.5	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–
80	43	21	–	–	–	–	–	–	–	–	–	0.5	–	–	–	0.5	–	–	–	–	–	–	–	–	–
81	26	29	12.0	0.5	–	–	–	–	0.5	–	1.0	0.5	–	–	–	–	–	–	–	–	0.5	–	–	–	–
82	45	21	0.5	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
83	81	47	24.5	5.0	–	–	–	–	10.0	1.0	0.5	5.0	–	–	4.0	0.5	1.0	–	–	–	–	–	–	–	–
84	33	29	0.5	–	–	–	–	–	0.5	–	–	0.5	–	–	0.5	–	–	–	–	–	3.0	–	–	–	–
85	46	21	–	–	–	–	–	–	0.5	–	–	–	–	–	–	0.5	–	–	0.5	–	–	–	–	–	0.5
86	40	21	0.5	–	–	–	–	–	4.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
87	23	29	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
88	92	18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
89	91	5	0.5	0.5	–	–	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	0.5	–	–	–	–
90	47	21	–	–	–	–	–	–	1.0	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–
91	53	42	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
92	24	29	1.0	–	–	–	–	–	0.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 79. Pollen counts from surface samples.

Sample No.	*Pinus*	*Alnus*	*Juniperus*	*Populus*	*Quercus*	*Celtis*	*Juglans*	*Salix*	*Gramineae*	*Cheno-am*	*Sarcobatus*	*Onagraceae*	*Sphaeralcea*	*Cleome*	*Ephedra nev.*	*Ephedra torr.*	*Umbelliferae*	*Labiatae*	*Low-Spine Compositae*	*Liguliflorae*	*Artemisia*	*High-Spine Compositae*	*Zea Mays*	*Unknown*	*TOTAL*	*Grains Counted*
1 Canyon Bottom	63	—	—	1	3	—	—	3	0.5	14	—	—	—	—	2	0.5	—	—	6	—	4	3	—	2	100%	221
2 Canyon Bottom	53	—	—	1	—	—	—	—	2	16	—	—	—	—	1	1	—	—	8	—	3	10	0.5	4.5	100%	224
3 Canyon Bottom	67	—	0.5	—	1	—	—	1	0.5	11	0.5	—	—	—	2	0.5	—	—	6	—	2	7	—	1	100%	204
4 Talus Slope	29	—	0.5	0.5	2	0.5	0.5	—	0.5	20.5	0.5	0.5	—	—	1	0.5	0.5	—	10	—	9	23	—	1	100%	229
5 Talus Slope	25	—	1	—	1	—	—	—	3	27	—	—	—	—	2	0.5	0.5	—	9	—	4	24	—	3	100%	249
6 Talus Slope	31	—	1	—	4	—	—	—	3	32	—	—	—	—	4	—	0.5	—	9	—	5	8	—	2.5	100%	232
7 Rim	51	—	0.5	—	5	—	—	—	—	12	1	—	—	—	5	0.5	0.5	—	12	—	1	8.5	—	3	100%	227
8 Seep/Spring	31.5	—	—	—	4	—	—	0.5	1	40	1	—	—	—	1	—	—	0.5	9	0.5	4	6	—	1	100%	212
9 Ledge	63	—	—	—	2	—	—	—	1	17	—	—	—	—	7	1	—	—	2	—	3	3	—	1	100%	219
10 Ledge	54	0.5	—	—	2	—	0.5	—	1	16	1	—	—	—	2	1	—	—	10	—	7	4	—	1	100%	215
11 Seep/Spring	39	—	—	—	16	—	—	—	0.5	27	0.5	—	0.5	0.5	1	0.5	—	—	6	0.5	3	4	—	1	100%	230

mophilous coprolitic pollen types usually are considered non-economic unless ethnographic records from the study area indicate an economic use of the plant. Even in such cases, only those coprolites which had anemophilous pollen percentages higher than that of the pollen rain represented in surface soil samples would be considered candidates for an economic interpretation.

Background Pollen.

Twenty-three of the 38 identified coprolitic pollen types are interpreted as resulting from incidental ingestion of normal background atmospheric pollen. Percentages of these types detected in the macrofossil portion of each sample are presented in Table 78. For comparison, the background types identified from the surface soil samples are presented in Table 79. Anemophilous non-economic taxa include *Pinus* (pine), *Quercus* (oak), *Alnus* (alder), *Juglans* (walnut), *Celtis* (hackberry), *Ulmus* (elm), *Artemisia* (desert sage), *Sarcobatus* (greasewood), *Ephedra nevadensis* (Mormon tea), *Ephedra torreyana* (Mormon tea), Gramineae (grasses), Urticaceae (nettles) and Cyperaceae (sedges). Zoophilous non-economic taxa include *Salix* (willow), *Sphaeralcea* (false mallow), *Eriogonum* (wild buckwheat), *Rhus* (sumac), *Polygonum* (knotweed), *Ribes* (wild black currant), Umbelliferae (parsleys), Malvaceae (mallows), Carophyllaceae (pinks), Nyctaginaceae (four o'clocks) and Onagraceae (evening primroses). The percentages of these zoophilous pollen types were felt to be too low to have resulted from economic use.

Economic Pollen.

Fifteen types of pollen were placed in the economic category, since their occurrence in the coprolites probably resulted from a dietary, medicinal or ceremonial use of the pollen itself or of the plants which produced the pollen. The majority of these pollen types are zoophilous (insect dispersed) and are transported by means other than air currents, so that they contribute little, if anything, to the pollen rain. It follows that the occurrence of zoophilous pollen types in fecal material is significant, as the pollen must have been introduced into the digestive tract by some means other than inhalation of pollen-laden air. Ethnographic records suggest how zoophilous pollen could have been ingested. The direct ingestion of male *Cucurbita* (squash, pumpkin) flowers by the Pima and Papago (Castetter and Bell 1942: 190) is one example. Ethnographic sources may also show the possibility of the economic use of certain anemophilous plants, as

in the cases of *Populus* (poplar, cottonwood) and *Juniperus* (juniper) (Castetter 1935; Whiting 1939). In such cases, percentages of coprolite anemophilous pollen types greater than the percentages seen in the surface soil samples (Table 79) were used in conjunction with ethnographic records for the Canyon de Chelly region to deduce an economic origin for the coprolitic pollen.

The 15 economic pollen types include the anemophilous taxa *Juniperus* (juniper), *Populus* (poplar, cottonwood), *Zea mays* (maize), *Typha latifolia* (cattail), Cheno-ams (goosefoot plus amaranth) and low-spine Compositae, and the zoophilous *Cleome* (beeweed), *Opuntia* (prickly pear cactus), other Cactaceae (cacti), *Cucurbita* (squash, pumpkin), *Portulaca* (purslane), highs-pine Compositae (sunflowers), Ranunculaceae (buttercups), Cruciferae (mustards) and *Phaseolus* (bean). Their occurrences in the microfossil portions of coprolite samples are presented in Table 80.

Populus pollen is present in 49 of the 92 coprolites, in high amounts in 10 (numbers 2, 6, 17, 30, 43, 49, 51, 61, 74 and 91); subsamples 6, 30, 49 and 91 contained from 91 percent to 100 percent *Populus* pollen. It is the most commonly occurring arboreal anemophilous pollen. While the 39 specimens having lower percentages are interpreted as representing background pollen, the 10 specimens having higher percentages must have resulted from cultural activity. *Populus* pollen accounted for only 1 percent of the pollen in surface soil samples. Castetter (1935: 43) states that the pollen-producing catkins of *Populus* were eaten raw by Pima women, in particular, and by the Pueblo Indians of New Mexico. Elmore (1943) notes that the Navajo chewed these catkins, alone or with animal fat, as gum; the prehistoric inhabitants of Antelope House may have done the same. As might be expected, no identifiable remains of chewed *Populus* catkins are seen in the coprolite macrofossils. As none of the ethnographies mentioned storage of *Populus* catkins, the pollen probably was consumed during the spring blooming period.

Juniperus pollen was found in 22 of the 92 coprolites, in significant amounts in three (numbers 43, 55 and 83). It is the second most common arboreal anemophilous pollen type.

Juniper is profusely anemophilous and could be considered as background. Subsample 55, however, contained clumps of juniper pollen grains suggestive of ingested anthers. Whiting (1939) notes that the Hopi prepared a medicinal tea from juniper twigs, as did the Zuni (Stevenson 1915). If such teas were prepared from pollen-bearing twigs, ingestion of the pollen would be very likely. The presence of juniper in these coprolites may indicate such a practice among the prehistoric inhabitants of Antelope House. No juniper macrofossils were recognized.

Cleome is the most commonly occurring pollen type and is present in 83 of the 92 subsamples. Sixty-three show high percentages of this zoophilous pollen, which is represented by only one grain in one surface sample. This is a good illustration of the low degree to which insect-pollinated plants contribute to the atmospheric pollen rain. Subsample 88 contained 100 percent beeweed pollen and numerous others contained 90 percent or more. Beeweed macrofossils were recognized in only 14 samples, but sample 88 contained 87 percent by weight of beeweed seeds.

The economic importance of uncultivated beeweed is illustrated by the Tewa and Hopi custom of naming the plant in songs, along with corn, pumpkin and cotton, the three chief cultivated plants. Young beeweed was boiled until concentrated and then dried for use as a winter food or a black pottery paint. The plant also was finely ground and taken with water as a remedy for stomach disorders (Robbins *et al.* 1916). The Hopi gathered the young plants and boiled the leaves and flowers for food (Castetter 1935; Whiting 1939) and the Zuni gathered and stored beeweed in large quantities for winter use (Stevenson 1915). Thus beeweed pollen could have been ingested at any time of the year.

Pollen of the Cheno-am type was seen in 70 of the 92 coprolites. The term Cheno-am is applied to pollen from genera of the family Chenopodiaceae (goosefoot) and the genus *Amaranthus* (amaranth) of the family Amaranthaceae, the grains of which are generally indistinguishable with the light microscope (Martin 1963: 31). Such genera include *Amaranthus, Atriplex, Chenopodium, Salsola* and *Cycloloma*. These plants are profusely anemophilous; their relative abundance in the surface soil samples is given in Table 79. The 40 percent Cheno-am pollen seen in surface soil sample 8 resulted from Russian thistle (*Salsola kali*) plants growing within sight of the sampling location. While it is thought that 40 percent rep-

Table 80. Percentages of economic pollen from coprolite samples (x indicates presence in pollen-deficient samples).

Sample No. Tamu/Fry	Room No.	*Juniperus*	*Populus*	*Zea*	*Typha Lat.*	*Cheno-am*	*High-Spine Compositae*	*Low-Spine Compositae*	*Cleome*	*Opuntia*	*Cactaceae*	*Cucurbita*	*Portulaca*	*Ranunculaceae*	*Cruciferae*	*cf. Phaseolus*
1 11	21	—	0.5	—	—	0.5	0.5	—	86.0	2.0	—	—	—	—	—	—
2 14	21	—	57.0	8.5	—	6.0	—	—	11.0	0.5	—	—	—	—	—	—
3 13	21	—	—	3.0	0.5	30.0	2.5	4.0	18.5	—	—	—	30.5	—	—	—
4 16	21	—	—	0.5	—	2.0	1.0	0.5	76.5	—	9.0	0.5	—	—	—	—
5 9	21	—	—	—	—	6.0	2.0	—	82.0	9.5	—	—	—	—	—	—
6 67	21	2.0	91.0	—	—	2.0	—	—	—	—	—	—	—	—	—	—
7 3	21	—	—	—	—	3.0	—	—	95.0	—	—	—	—	—	—	—
8 7	21	x	x	x	—	x	x	x	x	—	—	—	—	—	—	—
9 70	21	—	—	0.5	93.5	0.5	—	—	—	2.0	—	—	—	—	—	—
10 5	21	—	—	52.5	—	1.0	10.0	1.0	28.0	—	—	—	—	—	—	—
11 66	21	—	—	0.5	—	1.0	—	—	98.5	—	—	—	—	—	—	—
12 4	21	—	—	7.0	—	2.5	12.0	—	70.0	—	—	2.5	—	—	—	—
13 15	21	—	—	52.5	—	—	1.0	—	35.0	—	0.5	—	—	—	—	—
14 64	21	—	—	21.5	—	—	—	0.5	73.5	—	—	3.5	0.5	—	—	—
15 6	21	—	1.0	96.0	—	—	—	0.5	—	—	—	1.0	—	—	—	—
16 2	21	—	—	x	—	x	—	x	x	—	—	x	x	—	—	—
17 1	21	—	23.0	0.5	—	1.0	0.5	0.5	49.0	0.5	—	0.5	—	—	—	—
18 69	21	—	0.5	14.0	—	1.5	—	—	33.0	—	—	28.0	—	—	—	—
19 10	21	—	—	3.5	—	56.5	25.5	3.0	2.0	—	—	—	—	—	—	—
20 12	21	—	—	—	—	5.0	—	—	94.0	—	—	—	—	—	—	—
21 8	21	—	—	3.5	—	1.0	0.5	1.0	92.0	—	—	1.0	—	—	—	—
22 71	21	—	—	—	x	x	x	x	x	—	—	—	—	—	—	—
23 65	21	—	0.5	0.5	—	0.5	—	—	97.5	—	—	—	—	—	—	—
24 68	21	—	—	9.0	—	0.5	—	—	77.5	—	—	11.5	—	—	—	—
25 89	45	—	1.0	—	1.0	55.0	4.0	2.0	0.5	21.5	—	—	—	—	—	—
26 74	19	—	—	61.5	37.0	—	—	—	0.5	—	—	—	—	—	—	—
27 19	19	—	1.0	0.5	4.5	—	—	—	88.0	—	—	—	—	—	—	—
28 27	29	—	—	—	—	1.5	—	—	94.0	—	—	—	—	—	—	—
29 52	73	—	5.0	—	—	10.5	6.0	34.0	5.0	—	—	—	26.0	—	—	—
30 31	29	—	93.5	0.5	—	—	—	—	3.0	—	—	—	—	—	—	—
31 48	74	—	0.5	13.5	—	0.5	1.0	—	82.0	—	—	0.5	—	—	—	—
32 79	33	—	0.5	—	—	0.5	—	—	98.5	—	—	—	—	—	—	—
33 35	29	—	1.0	5.0	—	22.0	—	0.5	68.5	—	—	1.5	—	—	—	—
34 73	18	—	10.0	—	—	48.0	0.5	0.5	—	—	—	—	—	—	—	—
35 59	42	—	3.0	8.5	—	7.5	6.0	3.0	39.5	—	—	0.5	—	—	—	—
36 76	35	x	x	x	x	x	x	x	x	—	—	x	—	—	—	—
37 90	81	—	1.5	1.0	0.5	1.5	55.0	7.0	2.0	—	—	—	0.5	1.0	—	—
38 85	Kiva D	—	—	—	—	x	x	—	x	—	—	—	—	—	—	—
39 80	23	x	x	x	x	x	x	—	x	—	—	x	—	—	—	x
40 83	77	1.0	—	—	—	—	—	—	97.0	—	—	0.5	—	0.5	—	—
41 51	73	—	2.0	44.0	3.0	—	18.0	8.0	16.0	0.5	—	0.5	—	—	—	—
42 87	47	2.0	4.0	0.5	—	32.5	1.0	5.0	4.0	3.0	—	—	—	0.5	—	2.0
43 88	N251	32.0	31.0	1.0	1.0	5.5	1.0	3.0	1.0	—	—	—	—	—	—	—
44 84	35	x	—	—	x	x	x	—	—	—	—	—	—	—	—	—
45 72	23	0.5	0.5	10.0	—	3.0	4.0	0.5	28.0	22.5	—	—	—	—	—	—
46 75	89	—	—	1.5	—	0.5	0.5	0.5	92.0	2.0	—	—	—	—	—	—
47 56	42	—	—	5.0	—	4.0	0.5	—	89.0	—	—	0.5	—	—	—	0.5
48 34	29	1.0	1.0	3.0	1.0	2.0	1.0	0.5	71.5	—	5.0	1.0	—	—	—	—
49 77	26	—	100.0	—	—	—	—	—	—	—	—	—	—	—	—	—
50 62	42	1.0	4.0	51.5	15.0	7.0	1.0	2.0	4.0	—	—	—	—	—	—	—

continued

Table 80. Percentages of economic pollen from coprolite samples (x indicates presence in pollen-deficient samples)—Continued

Sample No. Tamu/Fry		Room No.	*Juniperus*	*Populus*	*Zea*	*Typha Lat.*	*Cheno-am*	*High-Spine Composite*	*Low-Spine Composite*	*Cleome*	*Opuntia*	*Cactaceae*	*Cucurbita*	*Portulaca*	*Ranunculaeceae*	*Cruciferae*	*cf Phaseolus*
51	25	29	—	13.5	5.0	—	2.0	—	0.5	74.0	—	—	—	—	—	—	—
52	86	23	3.0	1.0	7.0	0.5	54.0	1.0	4.0	14.0	—	—	—	—	—	0.5	—
53	41	21	—	—	2.0	—	—	—	0.5	95.5	—	—	0.5	—	—	—	—
54	90	81	—	3.0	1.0	1.0	2.0	23.0	37.0	0.5	—	—	—	—	—	—	—
55	61	42	9.0	1.0	8.0	—	39.0	11.0	11.0	9.0	—	—	—	4.0	—	—	—
56	18	29	—	0.5	—	—	0.5	—	—	96.5	—	—	0.5	—	—	—	—
57	28	29	—	8.0	6.0	—	1.0	—	—	80.0	—	—	—	—	—	—	—
58	60	42	—	—	13.0	0.5	6.0	1.0	0.5	71.5	—	—	0.5	—	—	—	—
59	32	29	0.5	1.0	8.0	2.0	10.5	2.0	1.0	52.0	—	—	0.5	—	—	—	—
60	36	29	1.0	7.0	2.0	—	4.0	2.0	1.0	65.5	—	—	0.5	—	—	—	—
61	20	29	—	72.0	1.0	—	—	—	—	26.5	—	—	—	—	—	—	—
62	21	29	—	0.5	—	—	1.0	—	0.5	91.0	—	—	4.0	—	—	—	—
63	54	42	—	—	98.5	—	—	—	—	0.5	—	—	—	—	—	—	—
64	22	29	—	—	—	0.5	—	—	0.5	97.5	—	—	—	—	—	—	—
65	82	42	—	0.5	8.0	5.0	16.0	0.5	2.0	3.0	—	—	—	—	—	48.5	—
66	55	42	—	1.0	1.0	—	2.0	1.0	2.0	64.0	—	—	0.5	—	—	—	—
67	63	42	1.0	2.0	49.5	—	4.0	2.0	5.0	—	—	—	—	—	3.0	6.0	—
68	29	29	—	1.0	6.0	—	0.5	—	0.5	88.5	—	—	—	—	—	—	—
69	37	21	—	0.5	0.5	—	—	—	—	95.5	—	—	0.5	—	—	—	—
70	58	42	—	—	12.0	—	—	—	—	84.5	—	2.0	—	—	—	—	—
71	30	29	—	0.5	2.0	—	—	—	—	95.5	—	—	0.5	—	—	—	—
72	38	21	—	—	1.0	—	—	—	—	94.0	—	—	2.0	—	—	—	—
73	49	73	0.5	—	15.0	0.5	8.0	5.0	0.5	16.0	—	33.5	—	—	1.0	—	—
74	17	29	2.0	13.0	10.0	5.0	7.0	2.0	2.0	19.0	—	0.3	—	—	—	—	8.0
75	39	21	—	—	0.5	1.0	0.5	—	—	97.5	—	—	—	—	—	—	—
76	78	82	—	—	1.0	0.5	77.5	12.0	4.0	1.0	—	—	—	—	—	—	—
77	44	21	—	—	9.0	14.0	7.0	0.5	—	68.0	—	—	—	—	—	—	—
78	57	42	1.0	1.0	20.0	1.0	3.0	9.0	2.0	29.0	—	—	—	—	—	—	—
79	42	21	—	—	1.0	—	0.5	2.0	0.5	93.0	—	—	0.5	—	—	—	—
80	43	21	—	—	—	0.5	—	—	—	97.5	—	—	—	—	—	—	—
81	26	29	—	3.0	8.0	3.0	6.0	3.0	0.5	59.0	—	—	1.0	—	—	—	—
82	45	21	—	—	0.5	—	1.0	0.5	—	96.0	—	—	0.5	—	—	—	—
83			13.0	2.0	5.0	4.0	13.0	1.0	5.0	—	—	—	—	—	2.0	0.5	—
84	33	29	—	0.5	1.0	—	—	—	1.0	89.5	—	—	—	—	—	—	—
85			—	—	2.0	—	0.5	—	—	88.0	—	—	—	—	—	—	—
86			1.0	—	2.0	1.0	17.0	1.0	0.5	71.0	—	—	0.5	0.5	—	—	—
87	23	29	—	—	—	0.5	—	—	—	97.5	—	—	—	—	—	0.5	—
88	92	18	—	—	—	—	—	—	—	100.0	—	—	—	—	—	—	—
89	91	5	—	—	—	0.5	97.5	—	—	—	—	—	—	—	—	—	—
90	47	21	—	—	0.5	—	0.5	—	0.5	93.5	—	—	2.0	0.5	—	—	—
91	53	42	—	100.0	—	—	—	—	—	—	—	—	—	—	—	—	—
92	24	29	—	—	—	—	—	—	—	97.5	—	—	—	—	—	—	—

resents the Cheno-am pollen maximum in the Antelope House area pollen rain, Bohrer (1968: 19, 25) reports a maximum of 59 percent Cheno-am pollen in a vegetational community dominated by *Atriplex* (a Cheno-am type) and *Sporobolus* (alkali sacaton) in east-central Arizona south of Canyon de Chelly National Monument. Thus Antelope House coprolite samples previously reported as containing more Cheno-am pollen than found in the pollen rain (Williams-Dean 1975; Williams-Dean and Bryant n.d.) may reflect only seasonal background pollen. Subsamples 76 and 89, however, contain 77.5 percent and 97.5 percent Cheno-am pollen, respectively, and these percentages must certainly result from economic use of the plants. Sample 76, in fact, contains 19 percent by weight of amaranth seeds.

The Tewa boiled and fried species of *Amaranthus* as greens and Santa Clara women and children chewed a species of *Atriplex* as a delicacy (Robins *et al.* 1916; 53, 58). The Pima boiled *Atriplex* flowerheads as a flavoring (Castetter 1935: 18). The Papago lived almost exclusively on soups made of fresh Cheno-am type plants as long as they were available (Castetter and Underhill 1935: 15), while the Yuma dried and stored the plants for later use (Castetter and Bell 1951: 201). The Navajo consumed large quantities of *Chenopodium,* either boiled or raw (Elmore 1943), and the Hopi ate both the seeds and flowers of *Chenopodium* (Castetter 1935: 22). The Havasupai boiled (Chenopodium leaves with salt or cornmeal and ate them as greens (Spier 1928: 107). Young *Chenopodium* plants were boiled with or without meat and eaten by the Zuni and the blossoms of *Cycloloma* were winnowed to recover the seeds. The seeds were then ground, mixed with cornmeal and steamed as balls or cakes (Stevenson 1915: 66, 67).

The consumption of these plants as greens could easily introduce Cheno-am pollen into the digestive tract if the flowers were not removed before cooking. Indeed, the examples of direct use of *Atriplex* and *Cheno-podium* flowers by the Pima and Hopi indicate selection specifically for that part of the plant. However, Bohrer (1968: 36, 38–39) demonstrated that Cheno-am pollen adhered to ripened *Chenopodium* and *Amaranthus* seeds beaten from inflorescences and that the pollen was abundant even after the seeds were winnowed. Thus flowers need not have been eaten to introduce Cheno-am pollen into the digestive tract.

Zea mays pollen was seen in 70 of the 92 coprolites. Subsamples 15 and 63 contained 96 percent and 98.5 percent maize pollen, respectively, and several samples contained 50 percent or more. Eighty-three samples contained maize macrofossils. Only one maize pollen grain was seen in the surface soil samples.

Maize is one of the three principal cultivated crops of the American Southwest and its pollen is one of the major ceremonial pollen types used in the region. It is a member of the grass family (Gramineae) and its pollen is wind-dispersed. Because maize pollen is so large and heavy, it does not travel more than a few feet from the parent source (Raynor *et al.* 1972; Martin and Sharrock 1964),thus behaving more like a zoophilous than an anemophilous pollen type. Maize pollen does not contribute significantly to the pollen rain and the presence of maize pollen in human feces probably results from its ingestion, either ceremonially or in the diet.

Hill (1938: 104, 138) notes a Navajo ceremonial offering in which a pinch of maize pollen was placed in the mouths of the celebrants. Robbins *et al.* (1916; 97) state that the Tewa at San Ildefonso recommended the taking of corn pollen with water for palpitation of the heart. Practices such as these certainly introduce pollen into the digestive tract and the resulting fecal mass; similar customs may have prevailed among the prehistoric inhabitants of Antelope House. For example, samples 10, 15, 63 and 67 contained large quantities of maize pollen, but few, if any, maize macrofossils.

The incidental ingestion of maize pollen in the course of a meal is another possibility. The Pima (Castetter and Bell 1942: 187), Yuma (Castetter and Bell 1951: 106) and Havasupai (Spier 1928: 104) consumed considerable amounts of green corn, either boiled or roasted. The Tewa (Robbins *et al.* 1916: 88–94) prepared numerous variations of boiled whole or ground corn, and the Navajo (Hill 1938: 45) chopped up entire ears of corn when they first came into silk and ate them boiled in a kind of soup. This last use, in particular, would seem to insure the ingestion of maize pollen, as the silks apparently were eaten with the rest of the corn cob.

That pollen is present on corn silks was demonstrated experimentally in July, 1974 (Williams-Dean and Bryant 1975). A volunteer consumed

approximately half the dried silks from the end of a mature ear of field corn, which had been exposed to daily wind currents and to at least one heavy rainfall. The resulting fecal specimen contained an abundance of maize pollen.

Bohrer (1968: 36, 47) suggests another way of incidentally ingesting maize pollen. She demonstrated that pollen adheres to the corn husk and is carried over to the kernel surfaces during the husking process. Several Antelope House coprolite samples contained maize pollen which appeared to have been chewed or ground, as with a mano and metate, and which could represent the grinding of pollen-covered maize kernels before cooking.

If the soups ascribed to various Southwestern groups were of the ever-renewing type (a sort of *pot-au-feu* in which the soup is never entirely consumed, but is added to each day), it is possible that maize pollen could be ingested in a stew mixture in which little or no evidence of corn macrofossils would remain. Thus the maize pollen in samples 10, 15, 63 and 67 could have resulted from a dietary practice. It also seems possible that maize could be eaten with little or no adherent pollen because the pollen had collected at the bottom of the pot. The majority of the coprolite samples containing evidence of consumption of maize have generally lower percentages of maize macrofossil weights. Such a "perpetual soup" is described by Castetter and Underhill (1935: 45) for the Papago, although the constituents of the gruel were not vegetables or greens, but various flours added to a cornmeal base.

Pollen of high-spine and low-spine Compositae appeared in 50 and 51 coprolites, respectively. Genera such as *Helianthus, Gutierrezia, Chrysothamnus* and *Aster* produce generally insect-dispersed pollen with surface spines greater than two microns in length (high-spine). Genera such as *Iva, Ambrosia* and *Dicoria* produce wind-dispersed pollen with surface spines less than two microns in length (low-spine). Both pollen types appeared in some coprolites in numbers greater than in the surface soil samples. Ethnographic records detail dietary or ceremonial uses for genera of both groups, which could account for the presence of the pollen in some of the Antelope House coprolite samples.

Martin and Sharrock (1964) concluded that the high-spine Compositae pollen found in their study of Glen Canyon coprolites reflected the background pollen rain, rather than economic use. While this may be true in many instances, I feel that high-spine Compositae pollen can reflect economic uses of the pollen or of the parent plants, especially when the percentages are greater in the coprolites than in the pollen rain of the area. In the case of the Antelope House materials, high-spine Compositae pollen accounted for a maximum of 24 percent in the surface soil samples and low-spine Compositae pollen accounted for a maximum of 12 percent. Subsample 37 contained 55 percent high-spine Compositae pollen; Subsamples 29 and 54 contained 35 percent and 37 percent lowspine Compositae pollen, respectively. Subsamples 37 and 54 may come from the same coprolite, as they have the same provenience and Arizona catalogue numbers. If they do represent different sub-sections of the same fecal specimen, then their differing percentages of Compositae pollen types illustrate the phenomenon of differential pollen distribution within a single coprolite (Martin and Sharrock 1964: 171; Williams-Dean 1975).

High-spine Compositae pollen could be mixed with seeds during harvest and could be ingested with them at a later time. Castetter and Opler (1936: 48) report that the Mescalero and Chiricahua Apache harvested sunflower (*Helianthus*) seeds by threshing or by holding a basket under the plant and sharply striking the back of the sunflower head with a stick, knocking the seeds into the container. Bryant (personal communication: 1974) demonstrated that pollen remains in ripened sunflowers by rubbing the seeds from wild sunflower heads into a container, rinsing the seeds, centrifuging the liquid and examining the residue. The residue was found to be rich in sunflower pollen, despite the fact that the flowerheads had been subjected to several rainstorms in an open field before being removed from their stalks. Bohrer (1968: 36) found that pollen adhered to sunflower seeds even after winnowing. Two Antelope House coprolites (numbers 19 and 29) contained identifiable sunflower macrofossils, as well as high-spine Compositae pollen.

Castetter and Opler (1936: 39) also describe the Apache practice of adorning a foodstuff (yucca pulp) with sunflower blossoms during preparation. Such ceremonial use of blooming sunflowers could result in pollen contamination of food without sunflower seeds actually being

eaten. For example, subsamples 37 and 54 contain high percentages of Compositae pollen, but no recognizable Compositae macrofossils. This Compositae pollen could also have resulted from a medicinal use of the parent plant, as in the Zuni use of *Gutierrezia* (snakeweed) blossoms in a tea ingested to relieve the retention of urine (Stevenson 1915: 53). Other coprolites of the Antelope House collection may also contain lower amounts of high-spine Compositae pollen resulting from an economic use of the parent plants.

Low-spine Compositae pollen is anemophilous, yet it appeared in subsamples 29 and 54 in almost three times the concentration found in surface soil samples. Such percentages may be indicative of economic use, despite the anemophilous character of the plants. The Hopi, for example, ground the flowers and seeds of *Dicoria* for food (Castetter 1935; Whiting 1939). Such a practice obviously would result in the ingestion of pollen and could account for the presence of low-spine Compositae pollen in the coprolite samples. The Navajo use of *Artemisia* plants as a substitute for toilet tissue (Elmore 1943) could also account for these presences if the pollen subsample included an uncleaned exterior surface. In any case, no recognizable macrofossils of low-spine Compositae were seen.

Cucurbita is another principal cultivated genus in the Southwest and its pollen was seen in 35 of the 92 coprolite samples. This zoophilous pollen type accounted for 28 percent and 11.5 percent of subsamples 18 and 24, respectively. These percentages are interpreted as resulting from economic use of the flowers. No pollen of this type was seen in the surface samples.

The Yuma boiled male and female *Cucurbita* flowers in salt water as food (Castetter and Bell 1951: 113). The Pima and Papago picked only the male, pollen-bearing flowers of the pumpkin for use as food, and dried and stored them to be cooked with mesquite beans or cornmeal (Castetter and Bell 1942: 190). The Navajo dried squash blossoms and boiled them as a seasoning with mutton tallow or meat (Hill 1938: 46), while the Havasupai mashed and boiled squash blossoms with green corn (Spier 1928: 115). The Zuni cooked squash blossoms in grease and ate them alone or with other foods (Stevenson 1915). All of these practices result in the ingestion of *Cucurbita* pollen, but do not yield identifiable *Cucurbita* macrofossils. Significantly, all identified Cucurbita macrofossils (seeds) occurred along with few, if any, *.Cucurbita* pollen grains in the coprolite samples. The ingestion of *Cucurbita* flowers alone, therefore, is strongly suggested.

Typha latifolia pollen was seen in 32 of the 92 coprolite samples and was a significant component of subsamples 9, 26, 50 and 77. Although the plant is anemophilous, ethnographic records suggest that the percentages present here (14 percent to 93.5 percent) result from economic use of cattail plants or pollen. For example, Elmore (1943) states that cattail pollen formerly was used ceremonially by the Navajo, but that maize pollen has since replaced it. Hill (1938: 104, 138) details Navajo ceremonies in which pinches of maize are placed in the mouths of the participants, providing a ready means for consumption of maize (formerly cattail) pollen.

The Mohave, Yuma, Cocopa and Maricopa tribes of the lower Colorado River gathered and consumed cattail pollen directly as a seasonal delicacy (Castetter and Bell 1951). The pollen was knocked off the dried cattail heads and eaten raw, boiled in water to make a gruel, used as a flavoring in mush or baked in flat cakes or thin sheets in a pit oven with hot coals to form brittle "cookies." It also was stored for future use. Cattail pollen in this area was an important seasonal food and was harvested annually, despite the tedious nature of its collection and preparation. The prehistoric inhabitants of Antelope House may have had a similar fondness for cattail pollen, as no recognizable cattail macrofossils were seen.

Pollen of *Opuntia* and other genera of the Cactaceae were seen in 16 coprolite samples, occuring in percentages ranging from 9 percent to 33.5 percent in subsamples 4, 25, 45 and 73. The cacti are zoophilous plants, and the presence of this pollen type in coprolites most likely comes from economic use of the flowers.

Castetter and Underhill (1935: 15, 16) report that the Papago fried *Opuntia* flowers in grease or that they pit-baked and dried them. Yanovsky (1936) mentions that the joints, buds and blossoms of *Opuntia* were steamed for food in California and New Mexico. Bryant (1974b), in a study of coprolites from southwest Texas, reports the presence of high percentages of Cactaceae pollen, which he felt resulted from the direct ingestion of flowers.

Bohrer (1968: 36) states that she recovered some *Opuntia* pollen from the outside surfaces of cholla cactus fruits and stems, which could also explain the presence of cactus pollen in the Antelope House coprolites. Bryant (1974b), on the other hand, recovered only a few grains when he conducted a similar experiment. Although cactus macrofossils were recognized from 45 of the subsamples, only a few cactus pollen grains are associated with them in the seven instances in which they occur together. Conversely, none of the high percentages of cactus pollen is associated with more than 2 percent by weight of cactus macrofossils. The ingestion of flowers alone seems certain.

Zoophilous *Portulaca* pollen was seen in 10 of the 92 subsamples. Nineteen contained purslane seeds. While ethnographic sources do not note the direct use of purslane flowers for food, the respective amounts of 30.5 percent, 26 percent and 4 percent seen in subsamples 3, 29 and 55 indicate that the pollen was ingested in some way. Whiting (1939) mentions that the Hopi cooked the plant in a gravy and Robbins *et al.* (1969) report that the Tewa boiled the tops of the plant for food. Castetter (1935: 43) states that the plant was used extensively for greens in New Mexico. The Navajo consumed the plant as a remedy for stomach ache (Elmore 1943). Such uses of the plant could have resulted in the ingestion of the flowers if they had not been removed prior to cooking. Perhaps significantly, samples 3, 29 and 55 contain high amounts by weight of purslane seeds. Bryant (1975) also found large amounts of purslane pollen in coprolites from Frightful Cave, Coahuila, Mexico.

Pollen from the family Ranunculaceae appeared in six subsamples, with a high of 3 percent in subsample 67. Although this family is zoophilous, a percentage as low as 3 percent suggests only marginal economic importance of the flowers. Elmore (1943), however, gives several Navajo uses for various genera of the family, including its use in teas for ceremonies designed to cure syphilis and as a source for ceremonial pollen. Whiting (1939) mentions the use of *Delphinium* as a emetic among the Hopi. Other uses are given by these authors for other parts of the plants, which would not necessarily result in pollen ingestion. No identifiable macrofossils of Ranunculaceae were seen in the coprolite samples.

Pollen from the zoophilous family Cruciferae was seen in 5 subsamples, with subsamples 65 and 67 containing a total of 48.5 percent and 6 percent, respectively. No pollen of this type was seen in the 11 surface samples. Many genera of the family are recorded as being used for food in the Southwest. Yanovsky (1936) lists the use of *Stanleya, Sisymbrium, Capsella* and *Lepidium* in teas, salads, greens or soups in California and Arizona. Coprolite sample 19 contained 32 percent by weight of *Lepidium* seeds, although no Cruciferae pollen was recognized in that sample. Castetter (1935: 25) states that the Pueblo Indians of New Mexico treated *Stanleya* as they did *Cleome,* for food. Whiting (1939) notes that the Hopi ate *Stanleya, Sopyia* and *Cleome* as greens in the spring. The Zuni spat powdered *Stanleya* plants on chancres as a cure for syphilis (Stevenson 1915). The Mescalero and Chiricahua Apache ate the tops of *Capsella* as greens, alone or with meat (Castetter and Opler 1936: 47). Any of these uses could result in the ingestion of Cruciferae pollen and a similar economic use of these or other genera could have been practiced at Antelope House.

Pollen grains which resemble *Phaseolus* were seen in four subsamples, with subsample 74 containing 8 percent. The identification of this grain is uncertain at present because our pollen reference collection does not contain sufficient pollen of different bean species.

This pollen could have been introduced into the digestive tracts in ways similar to those recorded in ethnographic accounts. Castetter and Bell (1951: 108), for example, note that the Mohave, Yuma and Cocopa occasionally cooked and ate bean pods before they were ripe. Pollen which might be adhering to the end of the pod could be ingested at this time. Mature beans were eaten shelled and bean macrofossils were recognized in four other coprolites. Stevenson (1915) reports a more direct means of ingesting bean pollen in her account of the Zuni cure for timidity. In this cure, bean leaves and blossoms were chewed by a warrior and rubbed onto the body of a timid infant boy, who was also given some crushed bean blossoms to eat. It seems likely that bean pollen would appear in the feces of both the officiating warrior and the child.

Dietary Change

The pollen counts for the 85 pollen-sufficient coprolite subsamples were compared in an effort to determine changes in economic pollen frequencies, which might reflect changes in food preferences or methods of preparation. Unfortunately, the sample size for periods earlier than LPIII (AD 1200–1300) was too small to yield meaningful results. The recognized economic pollen types occurred throughout the time span represented in the coprolite collection, with three exceptions. Pollen grains of the Ranunculaceae (buttercups) appear in one specimen from Pueblo II (AD 1000–1100), one specimen from EPIII (AD 1100–1150) and four specimens from LPIII. Pollen grains of the Cruciferae (mustards) appear in five specimens from LPIII. Pollen tentatively identified as *Phaseolus* (bean) appears in four LPIII specimens. No conclusions can be drawn from these data, however, because 64 coprolites out of 92 (70 percent) were recovered from LPIII fill. PI (AD 800–900) and MPIII (AD 1150–1200), on the other hand, are represented by single specimens. The chronology of the coprolite subsamples is given in Table 81.

The pollen data reveal the presence of maize, squash or pumpkin and, possibly, bean in the Pueblo diet, but they also reveal widespread use of wild or tolerated field plants, such as goosefoot (*Chenopodium*), amaranth (*Amaranthus*) and beeweed (*Cleome*).

Seasonality

Because the prehistoric inhabitants of Antelope House were agricultural and sedentary, storage of food in dried form probably was commonplace. This storage method frustrates the deduction of seasonality. In attempting to deduce seasonality at Antelope House, the coprolitic pollen record was relied on, since all of the plant foods represented in macrofossils could have been stored.

Castetter and Underhill (1935: 24–25) note that the Papago never stored seeds without first parching them, for fear of mildew. The seeds were parched in one of two ways. They either were shaken in a flat basket with a few embers or they were stired on a pottery sherd set over coals. The first method would almost certainly destroy any adherent pollen, but the second

Table 81. Chronology of coprolite samples by room number.

Period	*Room Number* 5	18	19	21	23	26	29	33	35	42	45	47	73	74	77	81	82	89	N251	Kiva D
PI																				
PI														31						
PII				53, 69, 72, 75, 77, 79, 80, 82, 85, 86, 90									29, 41, 73							38
EPIII							30, 51, 57, 68, 71							40						
MPIII									36								76			
LPIII		88		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24	39, 52	49	27, 28, 33, 48, 56, 59, 60, 61, 62, 64, 74, 81, 84, 87, 92	32	44	35, 47, 50, 55, 58, 63, 65, 66, 67, 70, 78, 91	25	42, 83				37, 54		46	43	
PIII	89		26		45															
Navajo		18-cyst 34																		

would not. The practice would be important in the case of high-spine Compositae pollen, for example, which Bohrer (1968: 36) found adhering to sunflower seeds after winnowing.

Another food stored after parching is green corn. The Hopi (Whiting 1939: 16, 69), Yuma (Castetter and Bell 1951: 106), Tewa (Robbins *et al.* 1916: 94), Pima and Papago (Castetter and Bell 1942: 187) and Havasupai (Spier 1928: 104) all relished green corn, as did Southwestern groups in general (Castetter and Bell 1951: 106). Green corn was prepared for winter use by various methods of roasting the ears, husked or unhusked (which may have destroyed the pollen), drying the maize on or off the cob, and storage, generally off the cob. The Mescalero and Chiricahua Apache stored green corn, husk and all, after an overnight steaming in an underground oven (Castetter and Opler 1936: 29). When desired for use, the dried product was boiled. Removal or retention of the corn silk is not mentioned. Analogy, then, suggests that green corn, which was sweet and could be eaten without grinding, could have been used at any time of the year at Antelope House. The same ethnographic sources, however, note that the vast majority of green corn was eaten fresh, almost to the exclusion of other foods. Castetter and Bell (1951: 106) state that the varieties of corn grown by Southwestern groups produced silks in about 60 days, at which time it was eaten as green corn; some green corn macrofossils, therefore, could carry a summer seasonality.

Other plants were dried without damage over fire or coals and were stored entire or as flowers, ensuring the appearance of their pollen in the feces of those who consumed them. The Pima and Papago (Castetter and Bell 1951: 190–191) gathered and dried male *Cucurbita* flowers to be cooked later with mesquite beans, as did the Navajo (Hill 1938: 46) for later use with mutton tallow or meat. The Papago gathered *Opuntia* blossoms and pitbaked and dried them for later use in a vegetable stew with *Atriplex* or *Chenopodium* (Castetter and Underhill 1935: 15–16). The Maricopa also dried *Opuntia* flowers (Castetter and Bell 1951: 201). The Isleta gathered large amounts of *Portulaca* and dried it for winter use as greens (Castetter 1935). The Zuni dried quantities of *Cleome* for winter use, as did the Navajo (Castetter 1935). Species of mustards (Cruciferae) were treated in much the same way as *Cleome* by the Hopi (Whiting 1939: 77) and by the Pueblo Indians of New Mexico (Castetter 1935: 25). The Cocopa, Yuma and Mohave cooked and dried *Amaranthus* (a producer of the Cheno-am pollen type) for later use and the Acoma and Laguna dried young *Amaranthus* for winter greens (Castetter 1935). The Navajo gathered *Zea* pollen when it first appeared and saved it for ceremonial use (Hill 1938: 46). The Mohave, Yuma, Cocopa and Maricopa gathered and stored *Typha* pollen for later use as food (Castetter and Bell 1951: 209–210).

Such ethnographic evidence from aboriginal groups surrounding the Canyon de Chelly area strongly suggests the similar treatment of similar taxa by the occupants of Antelope House.

The high-spine Compositae genus *Helianthus* (sunflower) was extensively used for its seeds by several Southwestern groups, but only the Mohave are noted for storing the seeds for later use (Castetter and Bell 1951: 196). As this storage was practiced only occasionally, the presence of high-spine Compositae pollen was not interpreted as representing storage.

Thus, of the 15 economic pollen types, eight (*Cleome*, Cheno-am, *Zea Cucurbita*, *Typha*, *Opuntia*, *Portulaca* and Cruciferae) were regularly stored by cultural groups in and around Canyon de Chelly National Monument and, therefore, were generally excluded from consideration in the attempt to infer seasonality. Speculation on the seasonality of the possible *Phaseolus* pollen type will be withheld until the grain is positively identified.

The background pollen percentages in and macrofossil data from the coprolites were studied together with the seven presumably unstored economic pollen types to infer seasonality of fecal deposition and site usage. Two major seasonality groupings, Spring/Summer and Four Seasons, were defined for the 85 pollen-sufficient coprolite subsamples. The coprolites were nearly equally divided between them.

The seven pollen-deficient subsamples (numbers 8, 16, 22, 36, 38, 39 and 44) may or may not reflect the absence of pollination, hence winter seasonality. An alternate factor affecting pollen presence in coprolites in habitation indoors, as at Antelope House, rather than in the open; the rock shelter and the pueblo would screen out much of the normal atmospheric pollen. Other factors are the diet components them-

selves. A meal consisting solely of meat or of meat and/or vegetables without inflorescences would result in little pollen in the feces. These seven coprolites, therefore, are of undeterminable seasonality and will be grouped with the samples comprising the Four Seasons category.

Spring/Summer.

Forty-two subsamples were assigned to this general category, which is characterized by high percentages of *Populus* (poplar, cottonwood), *Juniperus* (juniper), high- and low-spine Compositae, *Artemisia* (desert sage) and Gramineae (grass) pollen, as well as high percentage weights of *Opuntia* (prickly pear) seeds. Ethnographic accounts record economic usages for most of these taxa, which is the reason for considering some of them indicators of dietary usage. Few accounts, if any, record specific instances of storage of these items. These subsamples include numbers 2, 4, 5, 6, 10, 13, 17, 19, 21, 25, 29, 30, 33, 34, 35, 37, 41, 42, 43, 45, 46, 48, 49, 51, 54, 55, 57, 59, 60, 61, 66, 67, 70, 73, 74, 78, 80, 81, 83, 85, 86, and 91.

Populus and juniper pollinate in the early spring. Use of *Populus* catkins as food and of juniper twigs in a medicinal tea would introduce pollen to the digestive tract only in the spring, based on present evidence. The Compositae, Cactaceae and Ranunculaceae bloom in the late spring and summer. High-spine Compositae pollen adheres to sunflower seeds even after winnowing, as noted, but the seeds were stored only occasionally by the Mohave. Low-spine Compositae pollen-producing taxa were similarly unstored, according to present evidence. Desert sage may not have been used economically at Antelope House, although Elmore (1943) mentions its use by the Navajo in a medicinal tea. If such a tea were prepared with plants in bloom and if the small flowers were not removed, the amount of anemophilous desert sage pollen ingested would likely exceed the 20 percent maximum seen among Antelope House coprolites (subsample 54). Significantly, Wodehouse (1965: 516) states that desert sage is extremely abundant in arid and semi-arid regions and that it is an important cause of hayfever, outranking even the ragweeds in some parts of Arizona. Thus the relatively large percentages of desert sage pollen seen in some coprolite subsamples are felt to be the result of inhalation of airborne pollen. Grass pollen is also seasonally abundant and none of the ethnographies consulted record uses leading to pollen ingestion. Martin and Sharrock (1964) found large amounts of grass pollen, in association with chewed grass fiber, in human coprolites from Glen Canyon, but in these instances, the pollen percentages were in excess of 50 percent. Since none of the present coprolite samples contained more than 26 percent grass pollen, the pollen type is considered an indicator of a seasonal high in atmospheric pollen, rather than as an indicator of its economic use.

Prickly pear seeds denote economic use of the fruit, but the seasonality of use is difficult to determine. If the fruit were eaten fresh, the likelihood of swallowing some of the numerous small seeds is quite high. If the fruit were dried, however, the seeds may or may not have been ingested, depending on whether the seeds were removed prior to drying or eating. Ethnographic sources are vague about whether the seeds were removed prior to drying the split fruit, but Spier (1938: 107) notes that the Havasupai usually did not. The Havasupai soaked the dried fruit in water and then squeezed out the tissues to make a sweet decoction, which was drunk. While a few seeds might be swallowed in this way, the reconstituted fruit itself apparently was not used for food. Thus, in the absence of other ethnographic data, high percentage weights of prickly pear seeds in the Antelope House coprolites are taken to represent ingestion of fresh tunas as they became ripe.

Four Seasons.

Fifty subsamples were assigned to this category because their pollen and macrofossil contents are not diagnostic of any particular season. Both fractions are composed of items which could have been stored and ingested at any time of the year, as suggested by ethnographic analogy. These subsamples include numbers 1, 3, 7, 8, 9, 11, 12, 14, 15, 16, 18, 20, 22, 23, 24, 26, 27, 28, 31, 32, 36, 38, 39, 40, 44, 47, 50, 52, 53, 56, 58, 62, 63, 64, 65, 68, 69, 71, 72, 75, 76, 77, 79, 82, 84, 87, 88, 89, 90 and 92. The category also includes the seven pollen-deficient subsamples (numbers 8, 16, 22, 36, 38, 39 and 44).

All contained maize or cactus remains and 16 (numbers 12, 14, 18, 24, 27, 50, 53, 58, 63, 69, 72, 77, 79, 82, 84 and 90) contained charred or uncharred pine nut fragments. Most contained

the remains of seeds, such as amaranth (*Amaranthus*), goosefoot (*Chenopodium*), squash or pumpkin (*Cucurbita*), purslane (*Portulaca*), grass (*Panicum, Sporobolus*), or ground cherry (*Physalis*), and 11 subsamples (numbers 11, 23, 27, 28, 50, 62, 64, 84, 87, 89 and 92) contained varying amounts of cottonseed. The pollen portion of the coprolites was dominated by beeweed (*Cleome*), Cheno-am or maize pollen types, with other flower types occasionally represented. Four subsamples (numbers 3, 7, 9 and 63) contained insect remains and three (numbers 1, 7 and 89) contained remains of horsetail or scouring rush (*Equisetum*). Two (numbers 12 and 47) contained small stones. Subsamples 31 and 69 contained resin. Subsample 28 contained a large percentage weight of seeds identified as those of a squawbush (*Rhus*); while the fruit was used fresh in Utah, New Mexico, Arizona and California, it also was dried in these areas, presumably for use later in the year (Yanovsky 1936). The fruits were eaten fresh or after being ground to form meal by the Navajo, the Pueblo Indians of the Rio Grande Valley, the Hopi and the Mescalero Apache (Castetter 1935: 49) and were used to make "lemonade" by the Hopi (Whiting 1939). The Navajo also cooked the ground fruits with cornmeal to make a gruel (Elmore 1943). While the ingestion of recognizable seeds is not automatic in these instances, it is less troublesome to swallow the relatively large seeds along with the small fruits than it is to separate them. The ingestion of beans (*Phaseolus*) is evidenced in subsample 28. Grit is present in most samples, as is charcoal, and in some samples, one or the other of these items represents a substantial percentage of the weight. The dietary makeup of these subsamples is like that of the others, with meals composed of fresh or dried seeds and pot herbs, cactus pads and occasional insects. The macrofossil contents of the seven pollen-deficient subsamples are equally undiagnostic, being composed of maize and other seed remains, bone fragments, pine nuts and grit.

The dietary components of the 92 coprolite subsamples suggest a continuous occupation of Antelope House throughout the year. The ingestion of springtime *Populus* (poplar, cottonwood) catkins indicates the presence of the inhabitants in the area at that season. Such cactus products as flowers, fruits and the tissues of the pads themselves were available for use in one way or another year round and advantage was taken on them. Agriculture and gathering of other vegetal foods were practiced during the warm months. Occupation of the pueblo during the cold months cannot be empirically demonstrated, but can be suggested from the storable nature of the food remains recovered from the coprolites and from ethnographic records of the out-of-season use of these plants by aboriginal groups in the surrounding regions.

Summary

Of the 92 prehistoric human coprolite subsamples submitted for pollen analysis from Antelope House, 85 were found to contain sufficient pollen for a 200-grain count. Thirty-eight types of arboreal and non-arboreal pollen were identified, 23 types being interpreted as non-economic pollen and 15 as indicators of economic use of the parent plants or of the pollen itself. Ethnographic analogy with aboriginal groups in the region within and around Canyon de Chelly National Monument suggested ways in which the pollen could have been introduced to the coprolites. No dietary changes over time could be seen in the general Pueblo diet of maize, squash or pumpkin and beans because of the small number of coprolite specimens. Seasonality of site usage is postulated as year-round, with occupation during winter months being suggested by the storable qualities of the food items consumed.

Chapter 16

The Biology and Health of the Prehistoric Inhabitants

The prehistoric inhabitants of Canyon de Chelly are of particular interest to anthropologists for a number of reasons:

1. Little is known about them.

2. The Canyon de Chelly children exhibit an unusually high incidence of diet-related skeletal pathologies.

3. Ante-mortem tooth loss among the canyon's inhabitants appears to have been more frequent than among other Anasazi populations, hinting at an important difference.

4. The high mortality rate among Canyon de Chelly children suggests environmental stress resulting in death before child-bearing age. Of the 249 human skeletons recovered, 90 (36.1 percent) are of children under 12 years of age and a large percentage of these (56/90 = 62.2 percent) are infants.

5. Because of its location, Canyon de Chelly provided refuge for many ancient groups; for this reason, evidence of migration routes in this area may provide critical information for our understanding of Southwestern physical anthropology.

Skeletal Inventory and Analysis

The skeletal material is identified in Table 82. One hundred eight-two of the skeletons are stored at the American Museum of Natural History, New York; 18 at the Field Museum, Chicago; and 49 at the Human Variation Laboratory, Arizona State University, Tempe.

An initial attempt to describe separately the skeletal material from each site (Antelope House, Mummy Cave, etc.) was abandoned because of the nature of the skeletal material, its distribution in time and space and, most importantly, the small sample size.

Sexing.

Anatomical features of the pelvis were relied on whenever possible. These included the angle of the sciatic notch (narrow and deep in males, broad and shallow in females), presence of the pre-auricular sulcus and sub-pubic angle (90 or more indicates a female). When the innominates either were missing or fragmentary, less reliable characteristics were used. In males, these generally include the robusticity of the supraorbital ridges, size of the mastoids, muscular markings of the occipital bone and post-cranial region, more rounded orbital margins, thicker zygomatic arches, larger palate and teeth, and more massive lower jaw with a more strongly developed eminence.

Age at Death.

The most reliable indicators of age at death in skeletal remains are: (1) epiphyseal maturation of the public symphysis; (2) eruption of the deciduous and permanent dentition; (3) fusion of the basiocciput to the body of the sphenoid; and (4) ossification of the epiphyseal center of the postcranial skeleton. In the case of neonatal and infant remains, the sequence of dental eruption was the sole criterion used.

Age groups represented in the Canyon de Chelly sample are presented in Table 83. The mortality rate for infants and young children (0–6 years) is no higher than in other Southwestern skeletal series, where 50 percent commonly are under the age of 12 years. Of the total skeletal sample from Canyon de Chelly, 31.3 percent are of children below the age of 6 years and 36.1 percent of children 12 years or younger. The 22.5 percent mortality rate of infants (0–3 years) may reflect unsuccessful weaning; that is, a failure on the part of the infant to successfully make the transition from a lactiferous to a hard diet. The mortality rate decreases between the ages of 4 and 18. Deaths in this interval are attributed to diseases, avitaminosis, trauma, etc. Following a further decline in the mortality incidence during the sub-adult period, an increase is noted between the ages of 36 and 50 years (Table 84).

Stature.

Stature was estimated for 29 adult males and for 23 adult females. Genoves' (1967) regression formula for estimating stature was applied to the tibiae and femora, the only long bones used for this purpose. The resulting mean stature estimates are 166.8 cm for BMII-III males, 158.2 cm for BMII-III females, 165.6 cm for PI-III males and 157.0 cm for PI-III females. Although these estimates differ slightly from those for other prehistoric and historic Southwestern American Indians (Fig. 54), they fall within the range of expected variability.

Skulls.

Twenty-three measurements and 10 indices for the Basketmaker series and 21 measurements and seven indices for the Pueblo series were recorded and calculated. These were chosen to cover the major dimensions of the cranium, face and mandible in form, size and proportions. All measurements were made in millimeters. Cranial length and breadth were not recorded in the Pueblo series, because of the cradleboard flattening of the skull.

The mean, standard deviation, standard error and range for both males and females of the three temporal groups at Canyon de Chelly are presented in Tables 85 through 87. The T-test

Table 82. Skeletal identification.

Group	*Time (A.D.)*	*Adult Males*	*Adult Females*	*Sex Unknown*	*Children*	*Total*
Basketmakers	295–700	32	45	9	52	138
Puebloans	700–1300	35	23	15	38	111
						249

Table 83. Estimated age groupings (sexes pooled).

Age interval (years)	*n*	*%*
0–1	13	5.2
1–3	43	17.3
4–6	22	8.8
7–12	12	4.8
13–17	4	1.6
18–25	41	16.5
26–35	34	13.7
36–50	47	18.9
50–x	18	7.2
Unknown	15	6.0
Total:	249	100.0

Table 84. Male and female age distributions at time of death.

	Males			*Females*	
Age Class	*n*	*%*	*Age Class*	*n*	*%*
18–25	13	17.8	18–25	28	41.8
26–35	20	27.4	26–35	14	20.9
36–50	32	43.8	36–50	15	22.4
50–x	8	11.0	50–x	10	14.9
Totals:	73	100.0		67	100.0

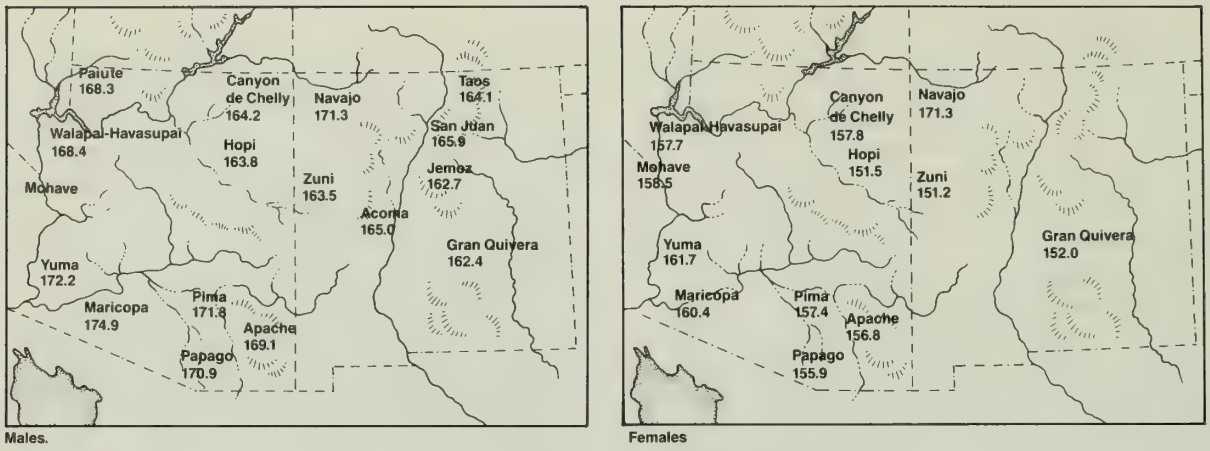


Figure 54. Mean stature of selected Southwestern Indian groups (in centimeters).

Table 85. Mean cranial dimensions, standard deviation, standard error and range: Basketmaker males and females (measurements in mm).

	Males					*Females*				
	n	*Mean*	*S.D.*	*S.E.*	*Range*	*n*	*Mean*	*S.D.*	*S.E.*	*Range*
Max. cranial length	32	175.1	8.3	1.59	150–188	49	165.9	6.2	1.09	150–179
Max. cranial breadth	31	131.1	7.6	1.46	124–155	46	130.4	5.1	0.90	122–149
Brasion-bregma height	27	133.6	5.5	1.05	125–151	40	129.6	4.3	0.85	124–136
Min. frontal breadth	30	91.3	4.3	0.86	80–100	48	87.1	3.5	0.64	83–100
Max. bizygom. breadth	22	134.2	8.0	1.74	122–144	38	126.8	5.9	1.17	121–139
Total facial height	17	116.8	6.1	1.69	108–128	32	110.5	6.8	2.01	98–120
Upper facial height	26	72.5	4.3	0.87	67– 84	37	66.7	3.3	0.65	67– 72
Basion-nasion	20	100.6	5.7	1.11	92–111	32	96.2	3.9	0.76	90–113
Basion-prosthion	19	99.2	4.4	0.89	88–107	33	92.6	3.3	0.67	85–105
Nasal height	16	51.5	2.7	0.54	46– 57	45	48.0	3.9	0.75	43– 55
Nasal breadth	15	25.4	2.4	0.48	20– 28	42	25.2	5.2	1.06	22– 30
Orbital breadth	29	36.5	2.0	0.40	35– 42	46	35.9	1.5	0.29	30– 40
Orbital height	29	36.5	2.0	0.40	32– 39	46	35.0	1.9	0.37	30– 38
Bi-orbital breadth	28	95.8	4.3	0.90	89–102	42	92.3	4.3	0.81	85–104
Maxillo-alv. breadth	24	67.1	3.3	0.84	65– 72	39	63.5	2.5	0.61	58– 66
Maxillo-alv. length	27	51.3	2.7	0.70	45– 57	35	48.6	3.1	0.74	45– 54
Bicondylar breadth	19	117.8	7.3	1.68	106–129	41	114.8	6.7	1.63	102–125
Bigonial breadth	22	96.3	5.1	1.14	86–103	43	89.9	8.0	1.93	84–100
Height ascend. ramus	19	63.0	4.7	1.02	54– 71	41	57.4	5.9	1.28	46– 67
Breadth ascend. ramus	20	35.1	3.2	0.69	32– 39	38	33.5	3.7	0.78	28– 39
Symphyseal height	28	34.1	2.3	0.50	29– 31	35	32.1	6.5	1.42	26– 37
Mandibular length	24	102.0	5.2	1.14	92–110	31	100.0	5.0	1.05	91–114
Coronoid height	26	64.7	4.6	1.15	59– 73	42	58.3	4.0	0.94	52– 63

Table 86. Mean cranial dimensions, standard deviations, standard error and range: Pueblo I and II males and females (measurements in mm).

	Males					*Females*				
	n	*Mean*	*S.D.*	*S.E.*	*Range*	*n*	*Mean*	*S.D.*	*S.E.*	*Range*
Brasion-bregma height	14	143.8	4.3	1.5	136–148	10	134.7	4.5	2.6	130–139
Min. frontal breadth	12	94.0	3.5	1.2	89–100	9	90.3	4.8	2.5	87– 93
Max. bizygom. breadth	12	139.1	5.5	2.0	131–149	10	124.0	7.2	4.2	118–132
Total facial height	10	125.7	4.6	2.7	123–131	8	113.0	1.4	0.7	112–114
Upper facial height	13	74.3	4.3	1.4	70– 80	9	64.5	6.4	4.5	60– 69
Basion-nasion	10	100.6	4.6	1.6	95–108	10	94.7	0.6	0.3	94– 95
Basion-prosthion	12	95.8	2.9	1.0	90–104	8	87.5	3.5	2.5	85– 90
Nasal height	10	50.0	3.6	1.2	45– 54	8	45.7	7.4	1.4	42– 48
Nasal breadth	11	25.1	1.5	0.5	23– 27	9	21.5	2.1	1.5	20– 23
Orbital breadth	13	38.2	2.7	0.9	36– 40	10	36.0	1.4	0.7	35– 38
Orbital height	12	34.5	1.6	0.5	33– 38	9	33.5	2.4	1.2	30– 35
Bi-orbital breadth	13	95.6	3.2	1.1	91–102	9	86.0	5.7	4.0	82– 90
Maxillo-alv. breadth	11	64.0	3.8	1.7	58– 68	8	60.5	3.5	2.5	58– 63
Maxillo-alv. length	11	48.6	0.9	0.4	48– 50	9	51.0	1.4	1.0	50– 52
Bicondylar breadth	14	125.2	4.9	2.2	119–130	9	110.2	9.3	3.8	100–125
Bigonial breadth	12	96.0	6.2	2.5	89–103	9	87.0	6.1	2.5	81– 99
Height ascend. ramus	14	58.5	4.8	1.9	54– 68	8	53.8	7.5	3.1	44– 61
Breadth ascend. ramus	11	34.7	2.3	0.9	31– 37	8	31.3	3.1	1.3	29– 36
Symphyseal height	10	35.7	1.7	0.7	32– 38	7	32.0	4.0	2.7	39– 40
Mandibular height	10	108.7	5.0	2.0	103–117	7	94.8	6.1	3.1	85–100
Coronoid height	12	64.0	5.6	2.3	55– 68	8	51.8	2.0	1.0	50– 54

Table 87. Mean cranial dimensions, standard deviation, standard error and range: Pueblo III males and females (measurements in mm).

	Males					*Females*				
	n	*Mean*	*S.D.*	*S.E.*	*Range*	*n*	*Mean*	*S.D.*	*S.E.*	*Range*
Brasion-bregma height	22	140.0	1.4	1.0	139–141	12	137.5	0.5	0.7	137–138
Min. frontal breadth	21	95.1	4.3	1.5	92–102	11	92.0	5.3	1.6	84–102
Max. bizygom. breadth	18	138.8	8.4	4.2	125–146	10	127.7	8.9	3.6	116–140
Total facial height	16	119.0	1.4	1.0	118–120	8	109.3	6.5	2.9	106–119
Upper facial height	21	67.7	3.4	1.1	63– 74	11	66.1	4.2	1.5	60– 71
Basion-nasion	20	99.3	6.7	3.8	96–102	10	96.3	3.4	1.7	93–102
Basion-prosthion	22	94.3	7.3	4.2	90–102	10	89.3	3.0	1.5	87– 91
Nasal height	20	49.6	3.7	1.2	43– 54	9	48.4	2.2	1.1	45– 53
Nasal breadth	19	35.7	1.6	0.5	23– 28	9	24.6	4.2	1.5	33– 27
Orbital breadth	23	37.2	1.9	0.7	36– 39	10	36.5	3.7	1.1	30– 40
Orbital height	24	35.0	2.0	0.7	33– 39	12	35.2	1.5	0.4	33– 39
Bi-orbital breadth	22	94.7	2.2	0.9	91–100	10	92.2	5.3	1.8	89–100
Maxillo-alv. breadth	20	66.0	2.0	0.9	63– 68	11	61.8	2.3	1.0	59– 65
Maxillo-alv. length	18	49.8	2.6	1.1	47– 52	10	46.6	3.2	1.4	42– 49
Bicondylar breadth	19	120.8	7.1	2.9	112–129	12	113.9	7.4	2.4	100–124
Bigonial breadth	23	103:2	7.3	3.0	90–109	12	94.2	6.7	2.0	84–106
Height ascend. ramus	22	63.1	5.9	2.2	56– 69	8	55.5	6.4	1.9	46– 64
Breadth ascend. ramus	17	34.4	2.6	0.9	31– 36	11	33.1	1.9	0.5	30– 38
Symphyseal height	21	34.0	2.2	0.8	30– 36	11	32.7	2.6	0.7	28– 37
Mandibular length	20	104.0	4.7	1.8	99–111	9	98.1	5.7	1.6	91–104
Coronoid height	17	66.8	4.5	2.0	62– 75	10	56.3	5.1	1.8	50– 68

was employed to determine the significance of the difference among and between males and females of the three periods (Tables 88 and 89). Mean cranial indices for the temporal series are presented in Table 90. Due to the small sample size and to the unavailability of precise dates, and Basketmaker II and III series are grouped together, as are Pueblo I and II.

In general, the skulls of prehistoric Canyon de Chelly residents can be characterized as follows (see Figs. 55, 56, 57):

Skull length and breadth. Basketmaker skulls are longer and narrower in both sexes than are those of Pueblo individuals, which are deformed.

Skull height. No apparent change occurs from Basketmaker to Pueblo times. All crania are high-vaulted, or acrocranic.

Table 88. T-values of within-group sex differences in the three temporal sequences.

	Basketmakers	*Pueblo I-II*	*Pueblo III*
Max. cranial length	4.81***	—	—
Max. cranial breadth	0.42	—	—
Basion-bregma height	2.94**	2.03	1.86
Min. frontal breadth	4.20***	1.00	0.95
Max. bizygom. breadth	3.61***	2.63*	1.40
Total facial height	2.44*	3.12*	1.83
Upper facial height	5.42***	1.87	0.63
Basion-nasion	3.25**	2.05	0.56
Basion-prosthion	6.00***	2.52	0.92
Nasal height	3.73***	0.94	0.62
Nasal breadth	0.17	2.29*	0.58
Orbital breadth	3.23**	1.22	0.38
Orbital height	2.82**	0.64	0.18
Bi-orbital breadth	2.91**	2.30*	0.86
Maxillo-alv. breadth	3.40***	0.66	2.18
Maxillo-alv. length	2.64**	1.00	1.29
Bicondylar breadth	1.27	2.43*	1.31
Height ascending ramus	3.36**	1.13	1.81
Breadth ascending ramus	1.51	1.54	0.90
Symphyseal height	1.32	1.59	0.81
Mandibular length	1.28	2.80*	1.68
Coronoid height	4.39***	3.30**	2.71*

* significant at the 0.05 level
** significant at the 0.01 level
*** significant at the 0.001 level

Table 90. Mean cranial indices of prehistoric Canyon de Chelly residents.

	Basketmakers		*Pueblo I-II*		*Pueblo III*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*
Cranial index	74.8	78.6	—	—	—	—
Height-length index	76.2	78.1	—	—	—	—
Total facial index	87.0	87.1	90.3	91.1	85.7	85.5
Upper facial index	56.5	60.4	53.4	52.0	48.7	51.7
Fronto-parietal index	69.6	66.7	—	—	—	—
Orbital index	97.5	97.4	90.3	93.0	94.0	96.4
Nasal index	49.3	52.7	50.2	47.0	51.8	50.8
Palatal index	130.8	130.7	131.6	118.6	132.5	132.6
Gnathic index	98.6	96.2	95.2	92.3	94.9	92.7
Manidublar index	86.5	87.1	86.8	86.1	86.0	86.1

Table 89. T-values of between-group sex differences in the three temporal sequences.

	Males			*Females*		
	Basketmaker-Pueblo I-II	*Basketmaker-Pueblo III*	*Pueblo I-II Pueblo III*	*Basketmaker-Pueblo I-II*	*Basketmaker-Pueblo III*	*Pueblo I-II Pueblo III*
Basion-bregma height	3.68***	1.53	1.07	1.51	2.51**	0.80
Minimum frontal breadth	1.21	1.59	0.40	1.13	1.44	0.37
Maximum bizygomatic breadth	1.22	0.79	0.05	0.58	0.21	0.45
Total facial height	1.85	0.47	1.64	0.48	0.22	0.69
Upper facial height	0.78	2.33*	2.64**	0.61	0.30	0.30
Basion-nasion	0.00	0.20	0.25	1.05	0.04	0.70
Basion-prosthion	1.58	1.21	0.35	1.95	1.46	0.46
Nasal height	0.92	1.19	0.17	0.62	0.23	0.72
Nasal breadth	0.27	0.26	0.60	1.07	0.30	0.97
Orbital breadth	0.70	0.19	0.67	0.09	0.52	0.22
Orbital height	2.11*	1.41	0.43	1.06	0.23	0.15
Bi-orbital breadth	0.10	0.49	0.87	1.53	0.04	1.09
Maxillo-alveolar breadth	1.26	0.55	0.77	1.14	1.01	0.40
Maxillo-alveolar length	1.87	0.80	0.78	0.95	0.93	1.52
Bicondylar breadth	1.68	0.65	0.85	0.92	0.23	0.62
Bigonial breadth	0.40	1.85	1.30	0.61	1.02	1.13
Height ascending ramus	1.18	0.03	0.85	0.89	0.60	0.34
Breadth ascending ramus	0.22	0.39	0.16	1.01	0.38	1.10
Symphyseal height	1.22	0.07	1.10	0.02	0.25	0.32
Mandibular length	2.08*	0.66	1.23	1.36	0.71	0.80
Coronoid height	0.20	0.67	0.62	2.63**	0.76	1.38

* significant at the 0.5 level
** significant at the 0.01 level
*** significant at the 0.001 level



Figure 55. An undeformed Basketmaker skull (left) and lamboid deformation of a Pueblo skull from Canyon de Chelly.



Figure 56. Pueblo (left) and Basketmaker male skulls from Canyon de Chelly.

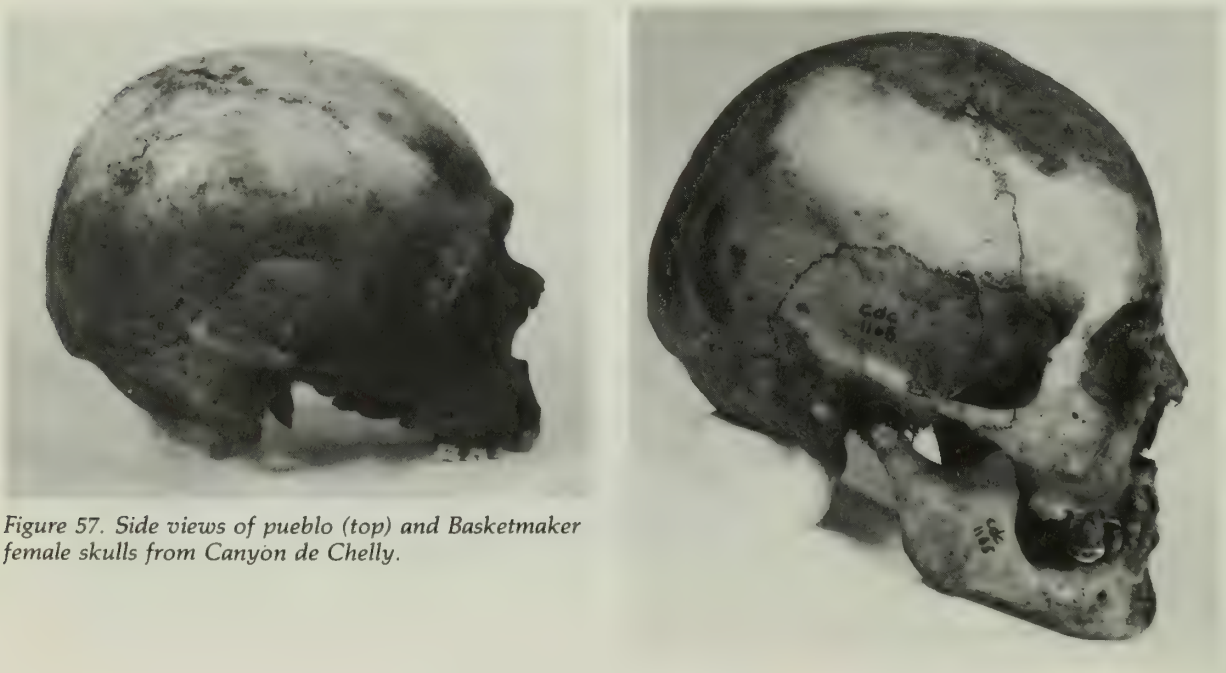


Figure 57. Side views of pueblo (top) and Basketmaker female skulls from Canyon de Chelly.

Upper facial height. This is highest in the Basketmakers. The Pueblo I and II groups are mesene or intermediate and the Pueblo III individuals are the shortest of the three groups.

Total facial height. Pueblo I and II are leptoprosopic or narrowfaced, while Basketmaker and Pueblo III individuals are intermediate or mesoprosopic.

Orbits. All Canyon de Chelly skulls fall in the hypsiconch, or high and relatively narrow, orbit category.

Nasal shape. Basketmaker females and Pueblo III males are platyrrhine, or broad-nosed. All other individuals have an average (mesorrhine) nose. In the male series, the trend from Basketmaker to Pueblo periods is toward a broader nose. In the female group, no definite trend is observed.

Palate form. All Canyon de Chelly skulls are brachyuranic (they have a short and broad palate). The palatal indices show a slight tendency to increase from the early to the late period.

Mandible. no apparent changes occur. All Canyon de Chelly skulls have a relatively moderate-sized mandible.

Prognathism. Except for the Basketmaker females, who are prognathous, all individuals are orthognathous or vertical-faced. The trend from Basketmaker to Pueblo periods is toward a decrease in prognathism.

Discussion

The skeletal series from Canyon de Chelly does not appear to be heterogeneous. Among males, Basketmakers differ significantly from Pueblo I and II individuals in only three characters (Table 89): basion-bregma height, orbital height and mandible length. Compared with Pueblo III individuals, Basketmakers differ only in upper facial height. Pueblo I and II individuals differ from those of the Pueblo III period in the same character. Among females, Basketmakers differ from the subsequent Pueblo periods in basion-bregma height and in coronoid height. None of the 20 measures tested between the two Pueblo periods shows a statistically significant difference.

With the exception of Basketmakers, the Canyon de Chelly people show few inter-sex differences (Table 88); the Basketmaker groups are far more variable in this respect than are either of the Pueblo groups. The Basketmaker group shows a significant difference in 17 of 23 measures (73.9 percent), Pueblo I and II in 7 of 21 (33.3 percent) and Pueblo III in 1 of 21 (4.7 percent). The increased variability among Basketmakers may be due to (1) sampling error, (2) age differences in composition of the sample, or (3) the possibility that more than one breeding group occupied the canyon at the same time or at slightly different times. The trend from Basketmaker to Pueblo times is toward an increase in homogeneity. The increased concentration around arable land during the intensive farming Pueblo periods may have led to a high incidence of inbreeding not found among the wider-ranging Basketmaker hunters, gatherers and part-time farmers. Archeological evidence, particularly site technology (De Harporte 1959: Steen 1966) shows that a continuum, rather than intrusion or replacement, seems to have characterized the Basketmaker to Pueblo transition at Canyon de Chelly. This corresponds to the homogeneous nature of the skeletal sample.

The Affinity of the Canyon de Chelly People

In this section, the physical characteristics of the Canyon de Chelly people are compared with those of six neighboring Southwestern Indian groups in an attempt to establish their biological affinity (Fig. 58). As a measure of the relative degree of biological similarity or differences between these groups, Clark's (1952) Coefficient of Divergence is used. The formula employed is:

$$C.D. = \sqrt{\frac{(a_1 - b_1)^2 + (a_2 - b_2)^2 \ldots\ldots\ldots\ldots + (a_k - b_k)^2}{K}}$$

Where $a_1 = \frac{A}{A_i + B_i}$ and $b_1 = \frac{B}{A_i + B_i}$

A_i = the mean of the ith measure in population A

B_i = the mean of the ith measurement in population B

K = the number of measurements

This is a simple and clear statistical technique, suitable for a study such as this, and provides a helpful objective summation of the differences between two sets of data.

According to Reed (1955), the Canyon de Chelly people are the westernmost representa-

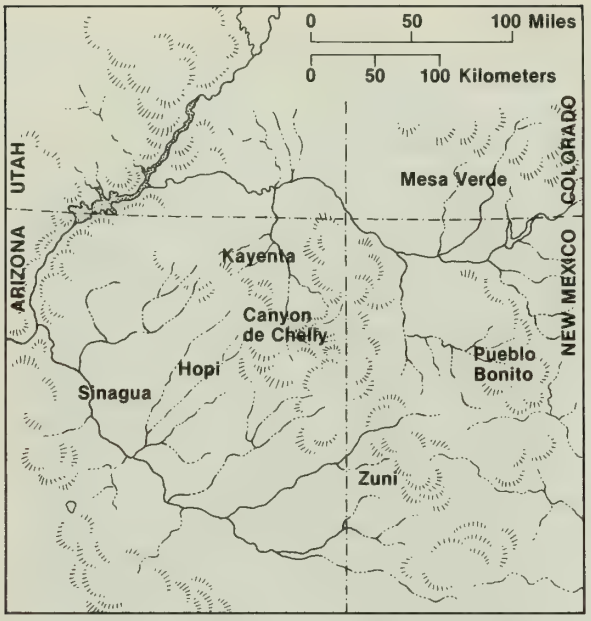


Figure 58. Locations of the six neighboring Indian groups with which the Canyon de Chelly population is compared for biological affinity.

tives of the Mesa Verde people of Colorado. This hypothesis is supported neither by the analysis of physical characteristics (Tables 91, 92, 93) nor by the known culture history of the Canyon de Chelly area.

The Canyon de Chelly people, on the basis of physical characteristics, are most similar to the Hopi and Kayenta people (Table 93). These findings are supported by the known culture history and by archeological reports from the area.

The present-day Hopi live on or at the base of three mesas and in nearby villages in northeastern Arizona. Their origin is mixed to such a degree that one speaks of the Hopi country as a melting pot (Ellis 1967). According to Ellis, the Hopi's basic nucleus seems to be a group of people speaking Hopi and/or a closely related Shoshonean tongue, who moved to the mesas about AD 1300 or slightly earlier.

There are several suggestions (Mindeleff 1895, 1897; Brew 1937; Reed 1946; E. Morris 1948; De Harporte 1959) that the Canyon de Chelly people moved to the Hopi country on southwestern Black Mesa at about AD 1300. Mindeleff (1891: 16–38) states that when the canyons north-

Table 91. Mean cranial dimensions of eight Southwestern Indian groups—males.

	Canyon de Chelly	*Sinagua*	*Kayenta*	*Zuni*	*Hopi*	*Chinle*	*Chaco Canyon*	*Mesa Verde*
Basion-bregma height	142.1	141.0	140.7	132.4	137.7	135.3	138.3	140.7
Min. frontal breadth	95.3	92.8	94.1	91.1	93.2	95.3	94.3	94.3
Max. bizygom breadth	139.8	131.9	136.7	130.7	137.1	127.6	130.5	134.5
Total facial height	125.7	121.5	120.0	118.6	118.7	118.3	127.7	118.2
Upper facial height	71.7	71.9	70.6	70.4	71.1	71.5	72.1	70.8
Basion—nasion	100.8	100.4	101.1	97.0	97.5	102.2	97.3	98.1
Basion—prosthion	95.3	96.7	95.0	93.6	95.9	101.2	94.7	93.5
Nasal height	49.7	51.7	50.1	49.2	50.3	49.5	50.9	49.9
Nasal breadth	25.4	25.5	25.1	24.7	25.2	26.4	23.6	25.2
Orbital breadth	37.5	37.6	37.8	36.2	37.8	37.8	37.9	34.8
Orbital height	35.2	36.2	35.6	34.6	34.3	33.8	35.7	37.3
Bi-orbital breadth	95.5	92.7	93.4	92.7	94.8	98.0	92.4	95.8
Maxillo-alveolar breadth	63.4	63.3	62.9	61.5	63.8	65.0	63.3	62.0
Maxillo-alveolar length	49.2	50.1	51.1	49.1	49.1	51.8	46.8	47.8
Bicondylar breadth	123.9	119.8	118.7	114.8	118.2	120.3	124.0	119.8
Bigonial breadth	100.4	97.9	97.9	95.2	97.1	102.3	100.0	99.8
Height ascending ramus	61.6	64.2	61.5	58.9	56.9	61.8	68.0	58.0
Breadth ascending ramus	35.4	34.0	34.5	33.6	34.8	36.0	36.5	35.3
Symphyseal height	34.6	31.9	33.8	34.2	35.0	35.8	35.3	33.5
Mandibular length	105.7	103.5	107.0	103.9	105.5	109.5	101.8	102.9
Coronoid height	64.5	61.3	60.3	61.6	61.6	63.3	66.0	59.2

east of Hopi were abandoned, the people apparently moved to the south edge of Black Mesa and to the Jeddito Basin, where they became indentified as Hopi. Mindeleff further states that the migration traditions of both the Bear and Horn clans of First Mesa place them in Canyon de Chelly before coming to the Hopi village. De Harporte states that "it is likely that the prehistoric Puebloan group of Canyon de Chelly forms a societal continuity and the descendants of this group may very well be the Hopi of the First Mesa villages" (1959: 1400).

The Kayenta people, a prehistoric group of the Anasazi culture tradition, occupied portions of northeastern Arizona and southwestern Utah from about AD 1 to AD 1300 (Lindsay 1969), when they abandoned their homes and migrated southward to Black Mesa, the present-day Hopi

Table 92. Mean cranial dimensions of eight Southwestern Indian groups—females.

	Canyon de Chelly	*Sinagua*	*Kayenta*	*Zuni*	*Hopi*	*Chinle*	*Chaco Canyon*	*Mesa Verde*
Basion—bregma height	137.0	136.0	133.3	128.4	132.3	130.0	137.6	137.3
Min. frontal breadth	91.5	88.5	92.4	88.4	92.2	93.0	92.1	89.3
Max. bizygom breadth	125.9	123.6	123.4	124.5	129.2	128.0	127.8	123.5
Total facial height	111.5	110.2	107.4	110.0	114.7	120.0	117.7	112.2
Upper facial height	65.9	65.9	65.0	65.3	65.9	69.5	68.8	63.0
Basion—nasion	94.4	95.2	96.2	91.9	97.4	92.0	94.1	95.0
Basion—prosthion	87.7	92.1	90.3	89.7	92.6	90.0	92.2	89.7
Nasal height	47.6	48.5	46.7	48.1	47.1	42.5	48.7	47.0
Nasal breadth	24.2	23.7	24.8	24.0	24.2	26.4	24.5	25.0
Orbital breadth	36.1	35.7	36.7	35.5	36.3	37.5	36.3	33.3
Bi-orbital breadth	91.5	89.3	87.3	88.5	92.2	94.5	89.4	93.7
Maxillo-alveolar breadth	62.5	59.7	57.4	59.0	62.3	65.0	60.4	61.0
Maxillo-alveolar length	45.7	47.7	45.2	46.2	45.9	48.0	47.0	43.5
Bicondylar breadth	113.2	112.7	108.6	109.2	113.8	118.0	111.4	114.1
Bigonial breadth	93.2	97.9	97.9	95.2	97.1	102.3	92.1	91.0
Height ascending ramus	54.3	58.9	54.4	52.4	55.0	59.0	57.8	57.5
Breadth ascending ramus	32.8	31.9	31.0	33.4	32.9	35.0	33.3	34.5
Symphyseal height	31.5	30.6	31.9	32.5	32.5	35.0	33.6	34.0
Mandibular length	97.0	101.8	100.4	99.4	98.6	104.0	100.9	103.0
Coronoid height	55.0	54.5	54.8	55.2	55.0	56.0	58.7	56.5

Table 93. Mean Coefficient of Divergence values (CD) for pairs of Southwestern Indian groups, ranked according to increasing values—metric features.

Males												
CdC		*KN*		*HO*		*SN*		*CC*		*MV*		*ZN*	
KN	0.0128	SN	0.0115	ZN	0.0129	KN	0.0115	CdC	0.0189	KN	0.0163	HO	0.0129
HO	0.0152	CdC	0.0128	KN	0.0137	CdC	0.0168	SN	0.0222	HO	0.0165	KN	0.0155
SN	0.0168	HO	0.0137	CdC	0.0152	AZ	0.0191	KN	0.0239	ZN	0.0170	MV	0.0170
CC	0.0189	ZN	0.0155	MV	0.0165	MV	0.0192	ZN	0.0268	SN	0.0192	SN	0.0190
MV	0.0192	MV	0.0163	SN	0.0197	HO	0.0197	HO	0.0268	CdC	0.0192	CdC	0.0210
ZN	0.0210	CC	0.0239	CC	0.0268	CC	0.0220	MV	0.0280	CC	0.0280	CC	0.0268
Females													
CdC		*KN*		*HO*		*SN*		*CC*		*MV*		*ZN*	
HO	0.0110	ZN	0.0154	CdC	0.0110	CdC	0.0164	HO	0.0164	CdC	0.0199	CdC	0.0142
ZN	0.0124	SN	0.0167	ZN	0.0160	HO	0.0166	CdC	0.0175	CC	0.0203	KN	0.0154
SN	0.0164	CdC	0.0168	CC	0.0164	KN	0.0167	SN	0.0195	HO	0.0211	HO	0.0160
KN	0.0168	HO	0.0171	SN	0.0166	ZN	0.0185	ZN	0.0201	ZN	0.0218	SN	0.0185
CC	0.0175	CC	0.0229	KN	0.0171	CC	0.0195	MV	0.0203	SN	0.0243	CC	0.0201
MV	0.0199	MV	0.0260	MV	0.0211	MV	0.0243	KN	0.0229	KN	0.0260	MV	0.0218

CdC = Canyon de Chelly CC = Chaco Canyon KN = Kayenta MV = Mesa Verde HO = Hopi ZN = Zuni SN = Sinagua

country, and to the Flagstaff region. Reed (1955) suggests that several major elements of the post-1300 Hopi culture are Little Colorado, rather than Anasazi, but it is possible that the Hopi language (related to the Paviotso and Ute-Paiute) was that of the Kayenta Anasazi.

There is evidence of the Kayenta cultural influence at Canyon de Chelly (De Harporte 1959). Kidder (1924) suggests that proto-Kayenta and Kayenta pottery are present in Canyon de Chelly and that the pueblo village of Mummy Cave in Canyon del Muerto was founded and built by Kayenta people during the 11th and 12th centuries. According to De Harporte (1959), 44 percent of the sherds found through the Basketmaker II period are Lino Black-on-gray. This is the same decorated pottery found in the Kayenta district (Haury 1936; Colton and Hargrave 1937). During the Pueblo II and III periods, gray and white pottery associated with the Kayenta branch represents 40.7 percent of the pottery sample from Canyon de Chelly and Canyon del Muerto (De Harporte 1959).

The conclusions drawn from the above statistical analysis should be viewed with caution. The nature of skeletal material and the problems encountered in using such material (e.g., sample size, condition and distribution through time and space) must be taken into consideration. The degree of similarity or difference between these groups is at best descriptive and does not necessarily imply genetic affinity. Section, gene flow and genetic drift may have acted singly or in combination at the same time or at different times to produce the observed similarities or differences. Similar diets and environmental conditions may also have played a role.

Health

Nutrition is closely related to survival. Patterns of nutritional stress can best be explained and made explicit when studied with respect to the different elements of the ecosystem in which human groups live. Environmental reconstruction of the vegetable, fruit and animal life used for nourishment is necessary for understanding the adaptive problems faced. This aspect of the biological effect of cultural factors (e.g., food preparation and diet) has to some extent been neglected by evolutionary biologists.

The residents of Canyon de Chelly, like most other Southwestern Indian groups, raised crops of maize, beans and squash. In addition, hunting of small game and gathering of wild seeds and fruits also were practiced. The canyon's inhabitants did not depend on irrigation for cultivation. No evidence of irrigation canals, terrances or dams is found either on the canyon floors or in rim areas (Steen 1966). The people of Canyon de Chelly apparently lived within the canyons and used the mesa tops for gathering pinon nuts and as a source for building timbers, firewood and game animals. Seasonal rainfall in the canyons is not as critical as in neighboring areas, since a good source of groundwater is available for agriculture. The fields at Twin Trails and Canyon del Muerto yield crops even in drought years.

Analysis of faunal remains from Antelope House revealed evidence of deer, rabbits, turkey and antelope (see Chapter 12 and 13). Animal products, however, were scarce in the diet of these canyon dwellers. The main dietary emphasis was on maize. Ninety-two percent of all fecal remains analyzed from Antelope House showed evidence of corn (see Chapter 14). Cactus pods also were eaten in large quantities at Antelope House and other wild plants, such as fruits, chenopods, amaranth, beeweed and other greens, provided fresh seasonal food.

Although several parts of the human skeleton may be indicative of nutritional stress, the permanent dentition and skull are examined here to provide evidence of health-related problems among the Canyon de Chelly people.

Dental Wear.

The wearing of the tooth surface appears to be a normal result of tooth structure, function, eating habits and food preparation. The degree of wear is also determined by the condition of the supporting bone and the periodontal tissues. Among the Basketmakers of Canyon de Chelly, 7.3 percent (4 of 55) show no wear in the upper jaw and 8.2 percent (4 of 49) show no wear in the lower jaw. In the Canyon de Chelly Pueblo group, 9.1 percent (2 of 22) show no wear in the upper jaw and 10.5 percent (2 of 19) show no wear in the lower jaw. The high degree of dental wear in both groups probably is the result of eating habits and of food processing techniques. Food preparation by grinding on sandstone me-

tates introduced grit and other abrasive elements into the mouth, as did the parching of corn in hot sand or ashes, leading to extreme dental wear.

Dental Caries.

Fourteen and one-half percent (8 of 55) of the adult Basketmaker individuals have one or more carious teeth in the upper jaw and 31 percent (15 of 49) have them in the lower jaw; 13.6 percent (3 of 22) of the Pueblo individuals have one or more carious teeth in the upper jaw and 26.3 percent (5 of 19) have them in the lower jaw. The differences between the two periods are not significant, suggesting that although some modification of eating habits took place, there were no major changes in the methods of food preparation and/or indietary constituents throughout the occupation of Canyon de Chelly.

The incidence of dental caries varies widely among prehistoric North American Indians. Leigh (1925) reports the following frequencies: Kentucky, 33 percent; Arikara, 28 percent; and Sioux, 11 percent. Hooton found dental caries in 45.8 percent of the males and 49.1 percent in the females from Pecos, with an increased incidence from early to late periods. Neumann and Disalvo (1959) found that caries were few among Indians on their native diets, but that caries increased with the adoption of modern diets higher in carbohydrates, lower in fat and protein and inadequate from the viewpoint of balanced nutrition.

Ante-mortem Tooth Loss.

Incidence of ante-mortem tooth loss is based on individual tooth count. At Canyon de Chelly, the average adult incidence of ante-mortem tooth loss is 17.8 percent in the upper jaw and 31.5 percent in the lower jaw among Basketmakers, and 16.1 percent in the upper jaw and 31.5 percent in the lower jaw among Puebloans. The most likely causes of ante-mortem tooth loss to tooth decay, periodontal disease and nutritional deficiency. Shaw (1962) states that acute protein deprivation causes a degeneration of the connective tissue components of the gingiva and the periodontal membrane, osteoporosis of the alveolar bone and retarded formation of the cementum. Vitamin C deficiency enhances gingival bleeding (Kerr 1962) because of altered capillary permeability. According to Kerr, Vitamin C deficiency also prevents repair of the periodontium in the face of chronic destructive periodontal disease, allowing the disease to progress much more rapidly. Both animal protein and foods from which Vitamin C can be derived were scarce at Canyon de Chelly.

Tooth loss in Canyon de Chelly is strinkingly high in comparison with other Southwestern groups, but the incidence of dental caries is not. Sinagua, Mesa Verde, Hopi and Old Mission Zuni show an average incidence of ante-mortem tooth loss that is half that of Canyon de Chelly. This suggests a rapid effect of the tooth-destroying forces, which can be viewed as more critical here than elsewhere in the Southwest. Tooth retention has, of course, adaptive value and from this data alone, a picture of heavy stress seems to emerge.

How food constituents affected the dental health of the Canyon de Chelly people cannot be precisely documented. We can only observe that the canyon habitat adversely affected tooth survival, possibly due to the overdependence on cariogenic maize and to a lack of dietary flouride, roughage and animal protein. Limited varieties of food, poor hygiene, food preparation techniques, mastication of plant roots, the use of teeth as tools, and other factors imposed by the environment undoubtedly contributed to the prevalence of dental wear, the high frequency of tooth loss and dental caries among the Canyon de Chelly people.

Porotic Hyperostosis.

Porotic hyperostosis is a descriptive term for skeletal changes consisting of a coral, or sieve-like, porosity of the outer surface of the cranial vault or parts of it (EL-Najjar *et al.* 1976).

Porotic hyperostosis, varying in degree and location, was observed in 110 (51.4 percent of the 214 skulls examined (Figs. 59, 60, 61; Table 94). The condition was not observed unilaterally. No cases of hyperostotic lesions were seen on the endocranial surface of the orbital roof or cranial vault. No lesions were found on the temporal bone or below the superior nuchal line of the occipital bone.

The incidence of porotic hyperostosis among children (0–10 years) is higher than in subadults and adults (11–50+ years). In the Basketmaker group, porotic hyperostosis occurs in 72 percent (36 of 50) of the children and in 36 percent (31 of 86) of the subadults and adults. This difference

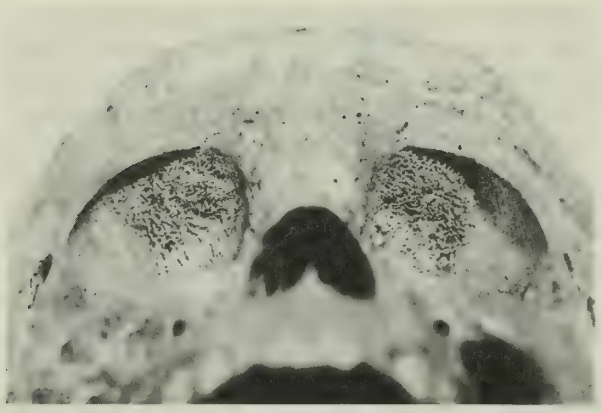


Figure 59. An example of porotic hyperostosis in the orbits from Canyon de Chelly.

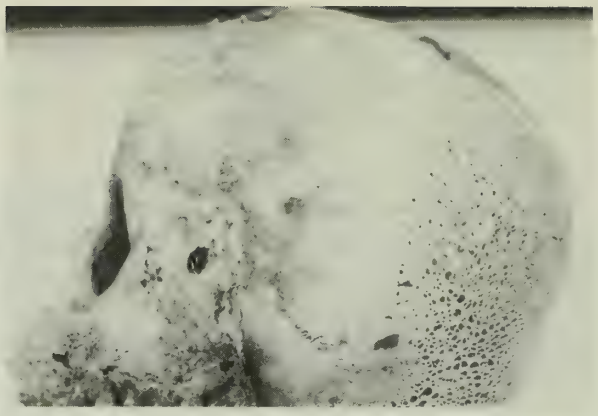


Figure 60. An example of porotic hyperostosis in the parietal bone from Canyon de Chelly.

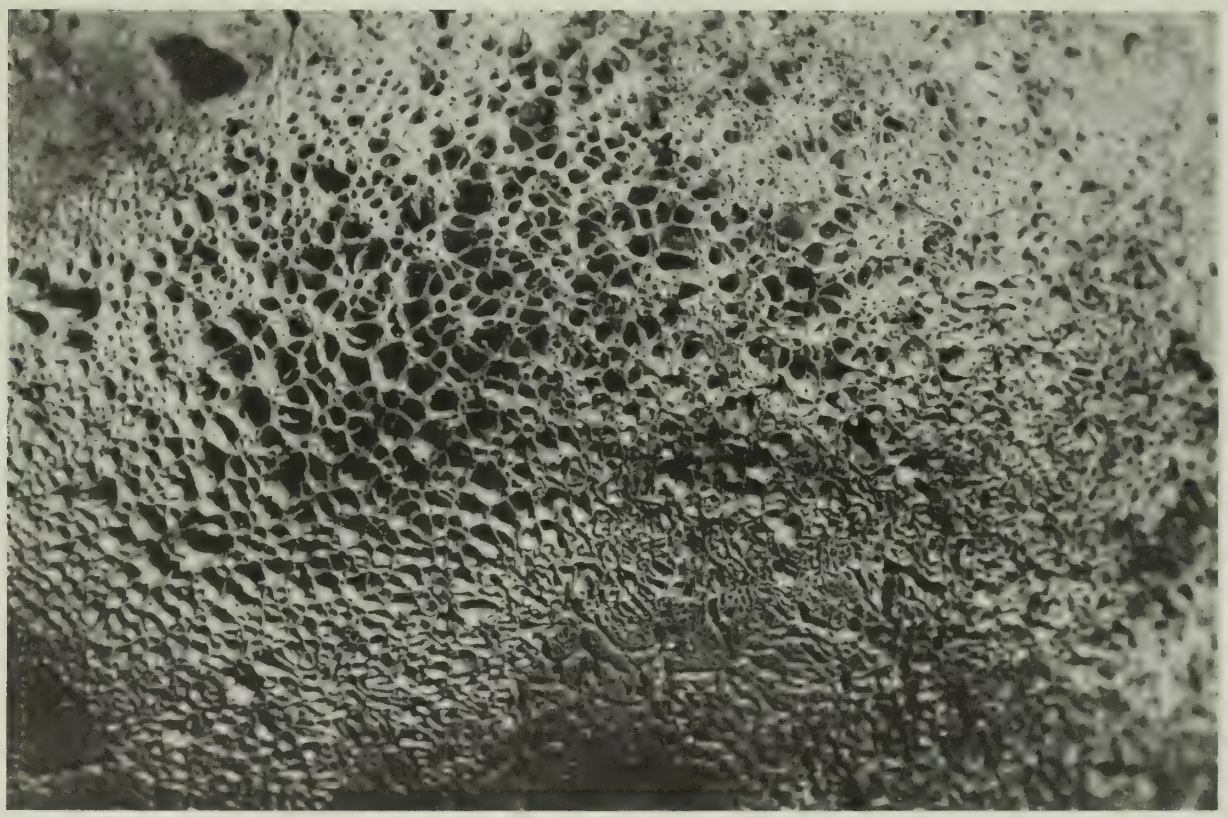


Figure 61. Close-up of Fig. 60. In severe cases the outer table of the skull becomes unrecognizable.

is highly significant ($x^2 = 16.46$, $P<0.001$). Among Canyon de Chelly Puebloans, porotic hyperostosis is present in 88.2 percent (15 of 17) of the children and in 45.9 percent of the subadults. This difference is also significant ($x^2 = 9.52$, $P<0.001$). The incidence is higher in adult females than in adult males for both the Basketmaker Pueblo groups. It also is higher in Pueblo children and adults than in Basketmaker individuals.

Initial attempts to explain the etiology of porotic hyperostosis in various human groups were handicapped by limited knowledge of bone pathology, radiology and congential hemolytic

Table 94. Total incidence of porotic hyperostosis in the cranial vault and orbits at Canyon de Chelly.

	Children (0-10 years)		*Subadults and Adults (11-50+ years)*							
			Males		*Females*		*Total (11-50+)*		*Grand Total*	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Basketmakers (AD 300-700)	36/50	72.0	9/23	26.5	22/52	42.3	31/86	36.0	67/136	49.3
Puebloans (AD 900-1100)	15/17	88.2	16/39	41.0	12/22	54.5	28/61	45.9	43/78	55.1

anemias. Earlier authors (see El-Najjar *et al.* 1976 for review) considered porotic hyperostosis to be a racial characteristic more frequently found in some human races (Mongoloid and Negroid) than in others (Caucasoid). Wood-Jones (1910) attributed the lesions to carrying heavy loads on the head (e.g., water jars). Moller-Christensen (Nathan and Haas 1966) hypothesized leprosy and enlarged lacrimal glands as possible causes. More recently, Henschen (1961) and Nathan and Haas (1966) proposed nutritional deficiency, as did El-Najjar *et al.* (1976).

In several publications, El-Najjar and coworkers (1975a, 1976a, 1976b) have hypothesized heavy dependence on a single food source (maize) as the major cause of porotic hyperostosis among Southwestern American Indians. Maize is known both to inhibit iron absorption (Ashworth *et al.* 1973) and is iron deficient for some species (Garretson and Conrad 1967). Iron absorption from maize is about 5 percent (Moore 1968), and maize in general has a poor availability of iron (Ashworth *et al.* 1973). Iron inhibition results from the high amounts of phytic acid and little or no phytase in the maize (Mollgaard *et al.* 1946; Fourman 1960). Phytic acid is an iron chelating agent, which renders iron unavailable nutritionally. Phytase is an enzyme, which counteracts the effect of phytic acid (Sodeman 1968; Kuhn *et al.* 1968; Amin and Hegsted 1971).

Not only is maize low in iron, but the iron present is poorly absorbed (Layrisse *et al.* 1969; Garretson and Conrad 1967). Iron from most vegetable sources (cereals, lentils, fortified bread, etc.) is similarly difficult to absorb (Layrisse *et al.* 1969; Martinez-Torres and Layrisse 1974; Natvig and Veller 1973; Wadell 1974). Animal iron apparently is more readily absorbed and used by the body to produce hemoglobin (Layrisse *et al.* 1969; Martinez-Torres and Layrisse 1974).

In living children between the ages of 6 months and 6 years, dietary insufficiency of iron is the most frequent cause of anemia (Smith and Rosello 1953). Iron deficiency anemia is quite common in diet deficient groups and is a major cause of infant morbidity (Wintrobe 1967). It also is known to produce retardation of skeletal growth during early life (Sax 1963; Sidhwa and Parekh 1964). The highest incidence of this anemia is found between 6 months and 3 years. At about 6 months of age, the infant has depleted the iron stores accumulated *in utero* and must depend on sufficient dietary intake to satisfy his metabolic needs. Also at this time, the infant starts a growth spurt, which will result in tripling of total blood volume and in doubling of the quantity of hemoglobin (Wintrobe 1967). Blood loss, insufficient iron storage at birth and gastroenteritis diesases will cause iron deficiency anemia much less frequently in infants and young children (Smith and Rosello 1953). An important factor in the frequency of roentgenographic changes in iron deficiency anemia is protein deficiency. Lanzkowsky *et al.* (1967) and Lanzkowsky and Rondebosch (1968) have shown that in 14 patients with protein malnutrition, the radioactive chromium half-life of labled erythrocytes was considerably reduced, ranging from 3 to 20 days, with a mean of 12.4 days.

Iron deficiency can result from foods lacking iron because of soil and/or groundwater iron deficiency (Wintrobe 1967), from foods naturally low in iron, or from food containing insoluble iron. Poor iron absorption also can be attributed to the amount of food bulk ingested. Large amounts of ascorbic acid, prolonged diarrhea, copper deficiency, intestinal parasites, Vitamin B_{12} deficiency, excessive calcium in the diet and proteinemia cause iron deficiency anemia (Powell *et al.* 1965; Wintrobe 1967).

Recent chemical analysis of prehistoric maize kernels from Antelope House shows it to contain enough iron, and groundwater analysis by Dutt and McCreary (1970) shows no lack of iron in the water. Soil analysis also shows evidence of enough iron. We suggest, therefore, that iron deficiency resulting in porotic hyperostosis is not the result of a nutritionally deficient environment and diet, but that iron was not used metabolically by the Canyon de Chelly people. Further analysis of phytic acid in maize and other food sources and of water alkalinity as iron inhibitors is necessary before any conclusions regarding the role of iron in porotic hyperostosis can be made.

At Canyon de Chelly and Canyon del Muerto, a seasonal lack of some part of the dietary complex, due to insufficient storage, extra long winters and occasional crop failure, occurred. As a consequence of the comparatively limited natural resources available for these agriculturally dependent people, some degree of malnutrition probably was not uncommon, although not necessarily severe. With carbohydrates as a main food resource, the Canyon de Chelly people, particularly during the intensive-farming Pueblo periods, were more apt to suffer from malnutrition than were the wider-ranging and more generalized hunters, gatherers and farmers of the Basketmaker periods. This is clearly seen in the changing frequencies of porotic hyperostosis in the Canyon de Chelly series from Basketmaker to Pueblo times (Table 94). Frequencies in children increased from 72 percent to 88.2 percent. In males, the incidence increased from 26.5 percent to 41 percent, and in females from 42.3 percent to 54.5 percent.

Summary and Conclusions

People of the Anasazi culture tradition lived in Canyon de Chelly and Canyon del Muerto from before AD 350 to about AD 1300. Throughout the occupation of these canyons, there appears to be a trend toward an increase in the degree of similarity in their physical characteristics. This trend most probably is the result of increased dependence on farm products, which brought more people together. In time, this may have led to a high incidence of inbreeding not found among the Basketmaker hunters, gatherers and parttime farmers. A similar environment would have produced less developmental variability among these canyon dwellers.

In their general morphology, the Canyon de Chelly people are not unlike neighboring Anasazi groups. Mean cranial measurements and indices fall within the range of variation of Southwestern Indian groups. Based on the present findings, the people of Canyon de Chelly are regarded as a generalized variety of the Southwest Plateau Physical variety, as described by C. Seltzer (1944). The Canyon de Chelly people were of average height; their estimated stature is very similar to that of modern day Puebloans (Hopi, Zuni, Acoma and Taos) and unlike that of the Yuman, Piman, or Athapaskan-speaking people, who are generally taller. Except for increased brachycephalization (round-headedness) in the beginning of the Pueblo I period (ca. AD 700), no apparent physical changes can be detected at Canyon de Chelly throughout its occupancy.

Except for the high incidence of ante-mortem tooth loss, prevalence of dental wear and high incidence of porotic hyperostosis, the Canyon de Chelly people can be considered generally healthy. The high incidence of ante-mortem tooth loss suggests rapid action of tooth-decaying forces, which can be viewed here as more critical than elsewhere in the American Southwest. The most novel finding of this study is the discovery of an unusually high incidence of porotic hyperostosis. This pathological condition occurs in a higher incidence among the Canyon de Chelly children than anywhere else in the New or Old Worlds. Severely restricted childhood diet, lack of certain essential elements in the dietary complex (e.g., iron and protein) and childhood illnesses are suggested here to have been the major causes of this disease.

Chapter 17

Diet Conclusions

A wide variety of edible plants and other foods are present in the archeological refuse of Antelope House. Analysis of this refuse through direct sorting of macrovegetal material, fecal analysis and studies of the pollen contents of vessels, both imbedded and loose, has demonstrated that several items were of more importance in overall subsistence at the site than were others. A few items usually thought to be important were not so confirmed by the study.

Beans (*Phaseolis vulgaris*) were present at Antelope House, but not in truly significant numbers in either the macrovegetal refuse or the feces. Although much of the bean would digest well, modern experimentation indicates that identifiable residues should be present. Scanning of vegetal constituents for parasites would have revealed these bean seed residues (H. J. Hall 1975: personal communication). We conclude that beans were not consumed consistently and that they were not important in the diet at Antelope House. Bean consumption is eclipsed by that of cotton seed, which probably provided many of the proteins and fats the beans would have supplied.

Corn was the dietary staple at the site, as evidenced by the numerous cobs recovered, the presence of maize in 92 percent of the feces, the presence of grinding implements with crushed maize pollen and the pervasiveness of maize pollen throughout the archeological deposit.

Indeed, the diet at Antelope House can be characterized as corn plus "whatever was handy." Nutritionally, these items are often significant, as apparently was the case with cotton seed and squash. Common gathered plants were beeweed (*Cleome*) and cactus of the genus *Opuntia*. The abundance of *Cleome* pollen, along with the relative rarity of *Cleome* seeds, supports the inference that it was used as a green to season the corn mush in the pot. Both pads and tunas of the cactus were consumed.

Rather than corn, beans and squash, we should see the diet at Antelope House as corn, cotton, cactus, *Cleome* and cucurbits. This vegetarian fare was supplemented with domesticated turkeys and game—mule deer, antelope and bighorn, in descending order of importance. Jackrabbits and cottontails, while eaten, were not consumed in significant quantities. Occasional meals of bear and bobcat may have been more important at some times, although neither seems likely to have been a dependable food animal and, on the basis of ethnographic analogy, they probably were not consumed at all.

Of all the potential food plants known from the area today, those most likely to have been consumed are those occurring in abundance throughout the area, such as pinyon, or those occurring in plant communities very close to the site. This suggests intensive use of the area surrounding the site, rather than forays to the upper canyon or to the Chinle Valley and indicates a lack of exchange or trade for gathered wild foods from these distant plant communities. Since an-

imals characteristic of these distant plant communities, such as the antelope, were hunted, hunting parties would appear to have been more wide-ranging than were gathering parties. If we assume that men did the hunting and that women did the gathering, it is evident that the men saw more of the distant countryside than did the women and that they must have made more wide-ranging contacts.

The pollen residues, plus two dirty vessels containing meal scraps, indicate that the common meal generally was prepared with ground ingredients, which were mixed together and simmered. It is not difficult to imagine this pot boiling continually, with new ingredients added as old contents were consumed. About a third of the meals must have included some form of meat, since 37 percent of the feces contained bone fragments. While meat may have been jerked to preserve it, we have no evidence of the practice; dermestid beetles would have consumed dried meat and scraps long ago.

As analysis began, we wondered about the nutritional "adequacy" of the diet, a concern prompted by the large mass of vegetal material and the relatively small quantity of bone material. Analysis and further thought indicates that the situation is not as extreme as it first seemed.

Consumption of meat more than a third of the time is indicated. Although below the norm for modern hamburger addicts, this amount of meat in the diet is within the bounds of biological adequacy. The high incidence of porotic hyperostosis reported by El-Najjar for the population in the canyon cannot be linked directly to obvious deficiencies in the diet at Antelope House.

Meat and animal protein came from two general sources at Antelope House, as they did elsewhere in the Anasazi area: from hunted animals and from domesticated animals. The hunted animals were principally mule deer, pronghorn, bighorn, jackrabbit and cottontail. The domesticated animals were the turkey and the dog; both of these were used for purposes other than food, so that their presence cannot be equated directly with a quantity of meat available for consumption. As McKusick emphasizes, the turkeys were kept primarily for feathers and were not consumed as frequently as at Mesa Verde. Simply because turkeys were present at the site does not mean they were available for the pot.

Comparison of the ratio of turkey meat to wild meat by period (Table 95) demonstrates that turkey meat consumption was roughly half that of wild meat for PII and Early PIII; the ratio rose considerably in Middle PIII (.62) and Late PIII (1.09). If all this meat actually was consumed, turkeys would have been the single most common meat. Whether this was the case is debatable. Although turkeys were raised primarily for their feathers, the dogs at Antelope House undoubtedly destroyed many of the turkey bones, so that that species is under-represented in the archeological record. We have no way of correcting for either of these factors; since they would tend to offset one another, however, the best estimate is that turkeys were a significant food source at Antelope House and that they increased in importance through the Pueblo III period. In Late PIII times, they must have been the most common meat, by far.

Table 95. Available wild meat vs. turkey meat, by period.

	P II	*EP III*	*MP III*	*LP III*
Wild meat in pounds*	843.7	588.25	1251.5	1838
Turkeys in pounds	464	280	780	2016
T/WM	55%	48%	62%	109%
Dogs in pounds	200	75	87.5	112.5
D/WM	26%	13%	12%	6%

* Sum of mule deer, antelope, bighorn, jackrabbit and cottontail by period.

We conclude that domestication of turkeys increased through time, probably as a result of the same factors that seem to have influenced the beginnings of plant domestication; that is, the need for more efficient use of a limited land area because of an expanding population (Boserup 1965). Turkeys began to become more important in Middle PIII times, the time during which the local population concentrated on the floor of the canyon.

The same cannot be said for dogs. Although a few were eaten, such an end was even less common for the canines than it was for the turkeys. The ratio of dogs to wild animals, measured in pounds, declines from .26 to .06 from PII to LPIII. If dogs are expected to be present in great numbers when hunting was a prominent pursuit, these data are directly contradictory.

The greatest decline occurs between PII and EPIII, when hunting, as shown by the quantity of animal bone on the site, increased dramatically. Jeffrey Dean (1976: personal communication) has pointed out that the hunting of antelope apparently declined along with the frequency of dogs; he suggests that dogs are more useful in hunting antelope than in hunting deer.

Chapter 18

Weaving at Antelope House

The vegetal artifacts from Antelope House were divided into five categories for analysis: textiles; sandals; twined cordage and knotted yucca; basketry and matting; and wooden and miscellaneous vegetal artifacts. This chapter deals with weaving and textiles in the broadest sense, including sandals and cordage; it concludes with a discussion of cotton and yucca behavioral chains. Chapter 19 offers a descriptive discussion of ceremonial, subsistence and miscellaneous vegetal artifacts. Chapter 20 reports the analysis of basketry and matting.

Method

Artifacts were cleaned prior to analysis. Cotton textiles were soaked in a lukewarm solution of water and a non-ionic wetting agent. Other artifacts were cleaned of surface dirt by brushing with a fine paint brush.

All textiles and sandals larger than 1 cm^2 were studied. With the exceptions of knotted corn husks, which were weighed, and of certain classes of worked twigs and bark, which were systematically sampled, all wooden and miscellaneous vegetal artifacts were studied. The bulk weights of cordage types were recorded by provenience and a systematic sample of cordage was submitted to intensive individual analysis. A policy of total analysis, rather than of sampling, was pursued in order to provide collections large enough to allow spatial and temporal studies of a statistical nature.

The chi-square statistic was used extensively in the sandal and textile studies to complement quantitative observations. Despite the large number of specimens analyzed, the study of textile and sandal traits involved small quantities for many specific traits. Thus the chi-squares sometimes were utilized under conditions in which the number of cases for some variables was small enough to allow sampling error to skew the results.

Descriptive variables and typologies used in the analyses reported here and in Chapter 19 were derived from Kent (1957), Tanner (1950) and Emery (1966) for textiles; from Kent (1954), Tanner (1950), Kidder and Guernsey (1919), and Anderson (1969) for sandals; from Kent (1954), Haury (1950), and Rohn (1970) for cordage; and from Bohrer (1962), Pierson (1962), and Anderson (1969) for vegetal artifacts.

Following is a list of selected technical terms, defined as used in this chapter and the next.

Anasazi stripe—self-patterned twill, using black or brown, red and white weft bands.

Beading—design technique involving narrow decorative strips made up of wefts of alternating color.

Brocade—design technique in which decora-

tive wefts alternate with basic wefts to form a floated design.

Embroidery—decorative technique in which yarns are inserted in a cloth after removal from the loom.

Hemming stitch—outline stitch which sews down a fabric edge.

Jogged toe—sandal toe shape in which the toe is curved to fit the contour of the human foot and in which there is a small projection at the position of the little toe.

Outline stitch—diagonal running stitch.

Overcasting—sewing technique in which yarns loop around the edge of the fabric.

Pile—twisted cord or yarn with hair caught between the twists.

Ply—a single twist of yarn.

Reply—yarn containing two or more spun and twisted yarns.

Rhythm—the regular number of warps each weft passes over and under; 2/1, for example, means over two and under one.

Running stitch—stitching technique in which the yarn is carried over and under the fabric surface.

Saddler's stitch—stitching technique in which the edges of two cloths are laced together without overlapping.

Self selvage—a non-reinforced edge on a woven cloth.

Selvage—special treatment of the edge of a woven cloth.

Square—thread count in which the number of warps equals the number of wefts per cm.

S-Spun—thread in which individual fibers are twisted together from left to right.

S-Twist—two or more plies of yarn twisted together from left to right.

Thread count—number of warps and wefts per cm.

Twinning—paired yarns which clasp one or more warps or wefts and make a half turn about each other.

Warp—a yarn stretched on the loom prior to weaving.

Warp face—warps obscure wefts from view.

Warp predominant—number of warps exceeds the number of wefts per cm; indicated as +N WA, where N equals the difference between the warp and weft count.

Warp-twined selvage—sandal heel selvage type in which edge warps are turned back and twined about the central warps.

Weft—yarn carried across the warps in weaving.

Weft face—wefts obscure warps from view.

Weft predominant—number of wefts exceeds number of warps per cm; indicated as +N WE, where N equals the difference between the weft and warp count.

Weft-wrap openwork—decorative technique in which small holes are made in the fabric by drawing apart certain warps and wefts and wrapping them with selected weft yarns.

Z-spun—thread in which individual fibers are twisted together from right to left.

Z-Twist—two or more plies of yarn twisted together from right to left.

Textiles

The 1289 textile specimens (totaling 167 m^2) from Antelope House were analyzed in order to reveal prehistoric behavioral patterns. The following hypotheses were instrumental in guiding the analysis:

1. Canyon de Chelly was a cotton-growing and textile-manufacturing area. This implies that the textiles represent products of local manufacture and that the entire ethnographically-derived cotton behavioral chain model (to be discussed below) may serve as a source of test implications for activities at Antelope House.

2. Based on the assumptions that men made the loom-woven textiles and that weaving was associated with kivas, the different kiva groups should have produced stylistically distinct textiles. This hypothesis is based on the notion, expressed initially by Deetz (1965), that stylistic ideas and habitual methods of stylistic variation are transmitted through interaction among artisans. Although the original work on this hypothesis focused on pottery, Hill (1970) had demonstrated that such logic also should apply to other artifacts. The closer interaction among artisans within a single kiva group than between members of different kiva groups invites one to expect stylistic variation characteristic of the various kiva weaving groups.

3. The North and South Room Blocks represented separate social units in PIII times. The architectural layout of Antelope House suggests a two-part division of society, in which kiva membership may not have cross-cut room blocks.

4. Increased environmental stress in PIII times led to the decreased use of cotton in non-essential tasks (i.e., tasks in which there was readily available substitute, such as yucca fiber for mending and for cordage) and to increased attempts at extending the use-life of textiles (i.e., mending and patching). This hypothesis is based on the assumptions that there was environmental stress in PIII times and that a generally non-food cultivar such as cotton, which is difficult to grow and which exhausts the soil, would be de-emphasized in favor of edible cultivars. As will be shown, the assumption that cotton was a non-food cultivar proved to be incorrect.

These hypotheses necessitated certain methods of analysis. First, textiles had to be studied as part of a system, from planting of cotton seeds to final discard of worn-out textiles. Secondly, analysis required that variations of a non-functional nature (i.e., stylistic and ideosyncratic motor habits) be isolated for comparison. Finally, spatial and temporal aspects of textile distribution had to be considered.

Before discussing the hypotheses in detail, the textile collection is discussed in terms of the major characteristics of the principal weaving techniques.

Loom-Woven Cotton Textiles: Descriptions

Approximately 157 m^2 of loom-woven cotton cloth, consisting of 1178 specimens, date from the Anasazi occupation of Antelope House. The earliest evidence of loom-woven cotton cloth comes from PI, but the bulk of the specimens date from PIII. Of the 1178 specimens, 86 percent are from proveniences dated between PI and Late PIII on the basis of dendrochronology, ceramics, archeomagnetism and stratigraphy. These dated specimens form the basic sample on which the following descriptive statements are based. In general, textiles come from secondary refuse deposits. Only a few were found in primary deposits, such as burials and caches. Recognizable artifacts are rare. Some blankets, bags and loincloths, however, are identifiable. The specimens represent three major weaving techniques: plain weave, tapestry and twill.

Plain Weave.

Plain weave, in which single weft yarns interlace over and under single warp yarns (Kent 1957: 489), is the dominant weaving technique (129 specimens, totaling ca. 156.64 m^2 of cloth). Two plain weave variations are present: multiple warps and weft-face. Two specimens have multiple warps acting as units. In one instance warps are paired, and in the other each weft passes over and under a set of three warps. Five specimens are weft-face; that is, the warps are completely obscured by the tightly tamped wefts. Nine specimens combine plain weave (three of which are weft-face) with other weaving techniques. These combination textiles are discussed below. Dated Anasazi proveniences account for 985 plain weave specimens—four from PI, 37 from PII, 19 from PIII, 29 from EPIII, 93 from MPIII and 803 from LPIII.

Warps and wefts are single-ply Z-spun cotton, with the exception of one regular plain weave specimen with 2-ply Z-spun S-twist cotton wefts. Warp and weft characteristics are summarized in Table 96. Plain weave textiles are 59 percent warp predominant (warps outnumber wefts per cm), 25 percent square (warps equal wefts per cm), and 16 percent weft predominant (wefts outnumber warps per cm). Warp predominant textiles range from +2WA to +9WA (i.e., from one more warp than weft per cm to nine more warps than wefts per cm). Likewise, weft predominant textiles range from +1WE to +9WE. The multiple warp textiles are warp predominant (+2WA and +5WA) and the weft-face plain weaves are weft predominant (+3WE to +9WE). Warp and weft counts for all plain weaves range from six to 18 per cm, the mode for warps being 10 and nine for wefts. Seventy-seven percent of the specimens fall within ± 2 of the mode thread count. The distribution of thread counts is graphed in Figure 62.

Most of the yarns are of undyed cotton, varying in color from white to light brown. Brown-black dyed textiles make up 12 percent of the regular plain weave collection and red-dyed constitute 4 percent. The dyes have not been chemically analyzed, but the deep saturation of the fibers in brown-black specimens suggests that such dyes are organic, rather than mineral. Specimens with dyed yarns do not differ significantly in any weaving characteristics from the plain weave collection in general.

Most plain weave (93 percent) is undecorated. Fifty-five specimens have stitching which may be embroidery, implying a decorative intent.

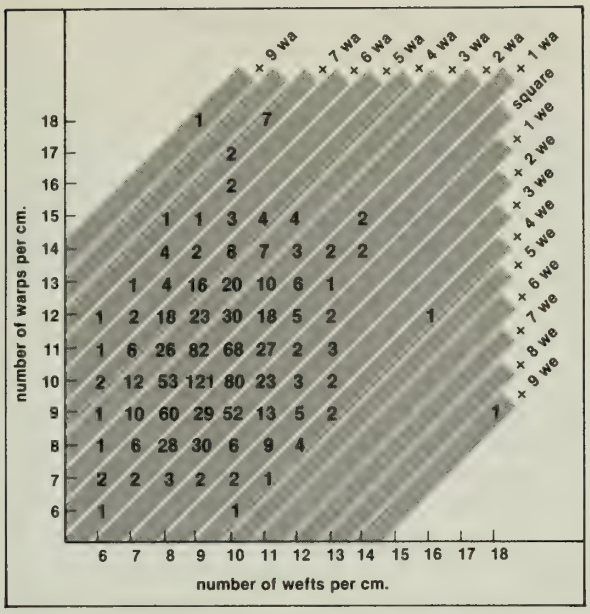


Figure 62. Distribution of thread counts in plain weave fabrics from Antelope House.

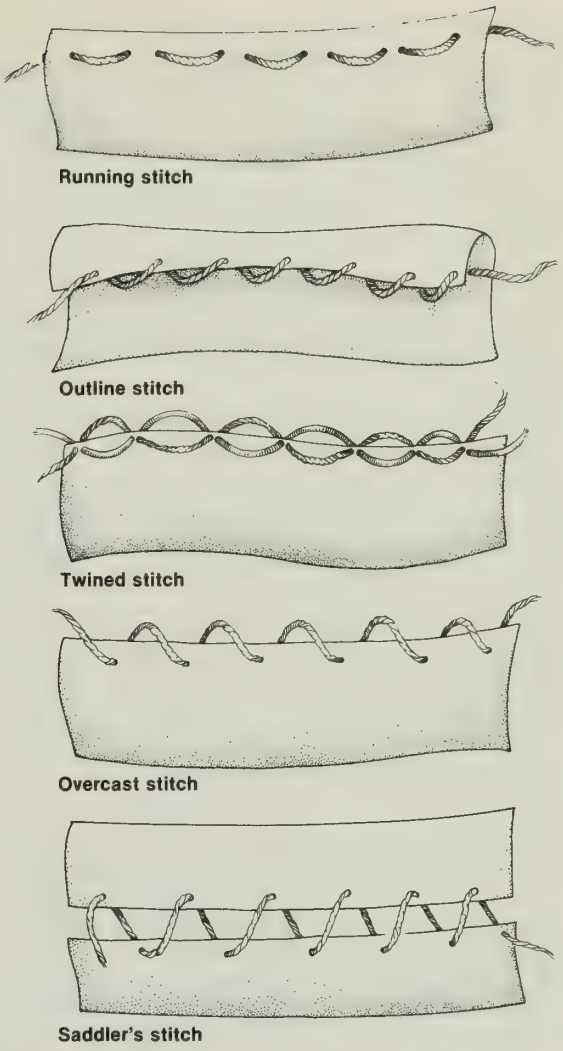


Figure 63. Stitch types used in selvages, embroidery, mending and patching from Antelope House.

At least half of the instances of stitching, however, may be viewed more properly as selvage reinforcement, since 53 percent of the stitching consists of one to three rows paralleling and beginning within 1 cm of an extant selvage. The most common form of selvage associated with stitching reinforcement is twined (89 percent), although a few cases of reinforced overcast selvages are present. Stitches used are 87 percent twined and 13 percent running. Stitch types are illustrated in Figure 63. Stitching yarns are cotton, with the exception of one instance of *Yucca baccata* fiber. Yarn color generally is natural, but 10 percent is dyed brown and 6 percent is dyed red. Characteristics of stitching yarns are summarized in Table 97.

The few remaining instances of decoration on plain weave include one Late PIII specimen with several rows of natural cotton brocade looped out at intervals on one side of the fabric; one Early PIII textile with two rows of contiguous squares formed in weft-wrap openwork, and two

Table 96. Warp and weft characteristics of major loom weaves.

	Plain Weaves N/%	*Twill Weaves* N/%	*Tapestry* N/%
Warp material			
cotton	1138/100	41/100	7/100
Warp ply-spin-twist			
1-Z	1138/100	40/98	7/100
2-Z-S	0	1/2	0
Warp diameter			
range (cm)	0.5-1.0	0.5-1.5	0.5-0.7
mean (cm)	0.5	0.5	0.5
Warp count			
range (# per cm)	6-18	6-15	6-12
mean (# per cm)	10	8	8
Weft material			
cotton	1138/100	41/100	7/100
Weft ply-spin-twist			
1-Z	1137/99.9	40/98	7/100
2-Z-S	1/0.1	1/2	0
Weft diameter			
range (cm)	0.5-1.5	0.7-1.5	1.0-1.5
mean (cm)	0.9	1.0	1.1
Weft count			
range (# per cm)	6-18	7-17	5-15
mean (# per cm)	9	11	10
Beaded weft count			
range (# per cm)		11-33	
mean (# per cm)		20	

Table 97. Textile embroidery and selvage reinforcement yarns.

	Plain Weave N/%	*Twill Weaves* N/%
Yucca baccata fiber	1/2	0
Cotton	54/98	2/100
natural	46/84	2/100
brown	5/10	0
red	3/6	0
Ply-spin-twist		
1–Z	3/5	0
2–Z-S	45/82	1/50
3–Z-S	5/9	1/50
4–Z-S	2/4	0
Diameter		
range (cm)	0.7–2.0	1.0–1.2
mean (cm)	0.8	1.1

Table 98. Selvage yarn characteristics.

	Plain Weaves N/%	*Twill Weaves* N/%	*Tapestry* N/%
Warp Selvage Material			
ply-spin-twist			
cotton			
1–Z	2/1	0	0
2–Z-3	94/64	0	2/67
3–Z-S	30/20	1/50	0
4–Z-S	11/7	1/50	1/33
5–Z-S	4/3	0	0
6–Z-S	1/1	0	0
7–Z-S	1/1	0	0
2–Z-S, 3 reply-Z	1/1	0	0
3–Z-S, 2 reply-Z	1/1	0	0
human hair			
2–Z-S	1/1	0	0
hair pile fine			
yucca fiber			
2–Z-S	1/1	0	0
Warp Selvage Yarn			
diameter			
range (cm)	0.4–2.5	1.0–2.0	1.0–2.0
mean (cm)	1.3	1.5	1.7
Warp Selvage Yarn			
color			
natural	111/85	1/50	3/100
dyed brown	15/12	1/50	0
dyed red	4/3	0	0
Weft Selvage Material			
ply-spin-twist			
cotton			
1–Z	1/1	0	0
2–Z-S	73/60	5/63	0
3–Z-S	32/26	3/38	0
4–Z-S	5/4	0	0
5–Z-S	2/2	0	0
6–Z-S	1/1	0	0
2–Z-S, 2 reply-Z	1/1	0	0
2–Z-S, 3 reply-Z, 2 reply-S	1/1	0	0
coarse yucca fiber			
2–Z-S	3/2	0	0
fine yucca fiber			
2–S-Z	1/1	0	0
hair pile fine yucca fiber			
2–Z-3	1/1	0	0
sinew	1/1	0	0
Weft Selvage Yarn			
diameter			
range (cm)	0.7–2.0	1.0–2.0	0
mean (cm)	1.4	1.6	—
Weft Selvage Yarn			
color			
natural	97/92	8/100	0
dyed brown	7/7	0	0
dyed red	1/1	0	0

weft-face plain weaves with some brown-dyed wefts which form bands and stripes. The multiple warp specimens also have weft bands and stripes, one in brown and the other in red and brown. There are two painted fabrics: a Middle PIII blanket from a baby burial has continuous red and white geometric designs running diagonally across the cloth (Fig. 64); the other painted textile is a poorly preserved Late PIII fragment with red lines paralleling the warps.

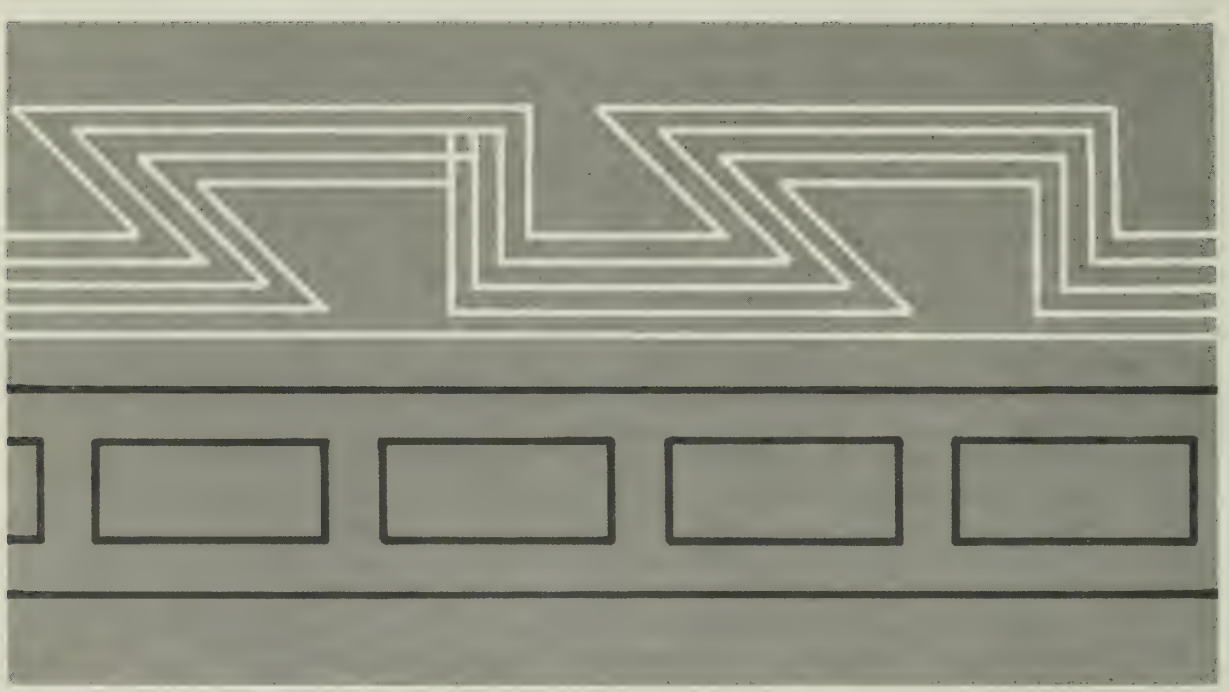
There are 106 instances of warp selvages on plain weave textiles. Twined (46 percent) and overcast (35 percent) are the dominant selvage types. Self selvages (7 percent) and a combination of twined and overcasting (1 percent) are less common. There are 97 cases of weft selvages. These selvages are predominantly overcast (48 percent) and twined (33 percent). Again present as minor types are self selvages (2 percent) and combinations of twined and overcasting (5 percent). Eighty-four textiles have edges hemmed with outline or running stitches. Selvage yarn characteristics are presented in Table 98. Thirty-three plain weave textiles have at least one warp and weft selvage present. In 21 cases, warp and weft selvages are of the same type (13 overcast and eight twined). Other combinations include warp twined/weft overcast (4 cases) and warp overcast/weft twined (1 case). Textiles possessing three selvages involve twined and overcast warp/overcast weft (6 percent), overcast warp/twined and overcast weft (3 percent), and twined warp/twined and overcast weft (3 percent). The painted blanket from the baby burial combines self and twined weft selvages with a twined warp selvage and a hemmed edge.

Most of the plain weave specimens are too fragmentary to determine their function, but four are blankets, three are loincloths and five are bags.

The blankets are extensively patched; indeed, three of the four are composed of fragments sewn together and it is impossible to determine which piece, if any, represents the original blanket. The three patchwork blankets are Late PIII. One consists of 16 fragments sewn together with twined, overcast and running stitches to create a cloth measuring 1.3 m by 1.0 m. The second blanket is composed of 27 patches sewn together with overcast, outline, saddler's and running stitches to form a cloth measuring 1.2 m by 0.8 m. The third blanket measures 0.73 m by 0.62 m and is formed of 10 plain weave fragments sewn together with overcast stitches. The most complete blanket comes from a Middle PIII baby burial, in which it was wrapped around a cradle. The weft dimension is complete at 1.52 m and the warp dimension is incomplete at 1.25 m. This is the painted blanket illustrated in Figure 64.

The loincloths are rectangular strips of cloth, narrowing slightly from the top edge, which is folded over to form a loop through which a belt would have passed. The edge is folded over from 6 cm to 12 cm. The woven sections from the fold to the opposite edge of the fabric measure 1.5 cm and 21 cm long on the two relatively complete specimens. The widths of the loincloths at the fold are 12.5 cm and 12.7 cm. The edge opposite the fold ends in fringe formed of 6-ply S-twist warp ends. In one instance, the fringe extends 13 cm and ends in a knot. In the other case, the fringe is knotted 2 cm from the base of the weaving and a single cord (2-ply Z-spun S-twist 3-reply Z-twist) extends 30 cm from this knot. All that remains of the third loincloth is a small fragment of the folded edge. It is Late PIII and consists of plain weave with a decorative front employing paired warps and brown-dyed wefts, the latter forming bands and stripes.

Three of the bags appear to be recycled cloth fragments. Two of these are Late PIII and are formed from rectangular pieces of fabric folded and sewn up the sides. One is 9.0 cm by 4.5 cm and the other is 14.0 cm by 8.5 cm. Both bags are sewn with 2-ply Z-spun S-twist cotton thread, one utilizing saddler's stitches and the other overcasting. The third bag made of recycled textile fragments is composed of two rectangular pieces sewn together on three sides with overcast stitches of 2-ply Z-spun S-twist cotton. The bag measures 8.5 cm by 5.0 cm. Two cotton plain weave bags were found inside a basket in a ceremonial cache (Fig. 65, 66) and will be discussed further in Chapter 19. One of these bags measures 10.0 cm by 4.5 cm and is made of a rectangular piece of cloth folded and sewn up one side with overcasting, using 2-ply Z-spun S-twist *Yucca* sp. yarn. The base of the bag is closed by means of a yucca fiber drawstring. The second of these bags consists of three strips of cloth sewn together with saddler's stitches, using 2-ply Z-spun S-twist cotton and bark yarns. The bag is 31.0 cm long and 6.7 cm wide.



Red (approximation)

Figure 64. Geometric design on a Middle PIII blanket recovered from a baby burial.

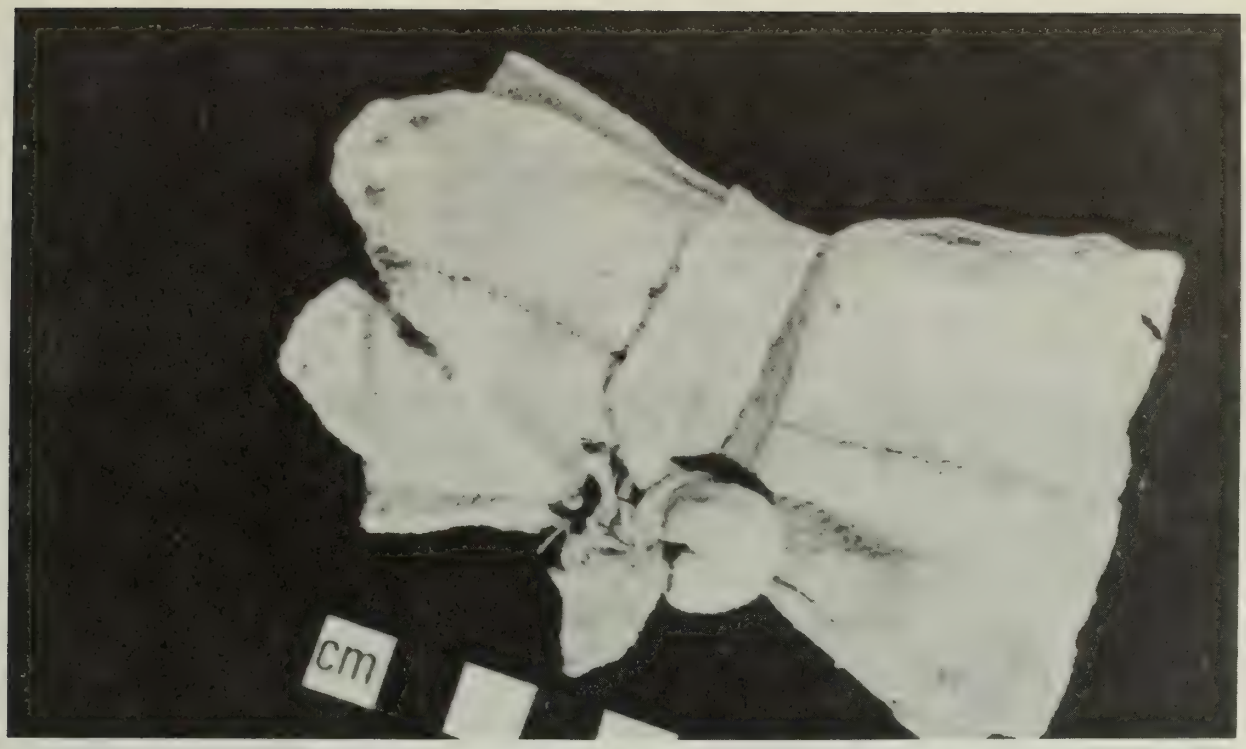


Figure 65. Plain weave cotton bag tied into a bundle with a hide strip, which also forms a small bundle.

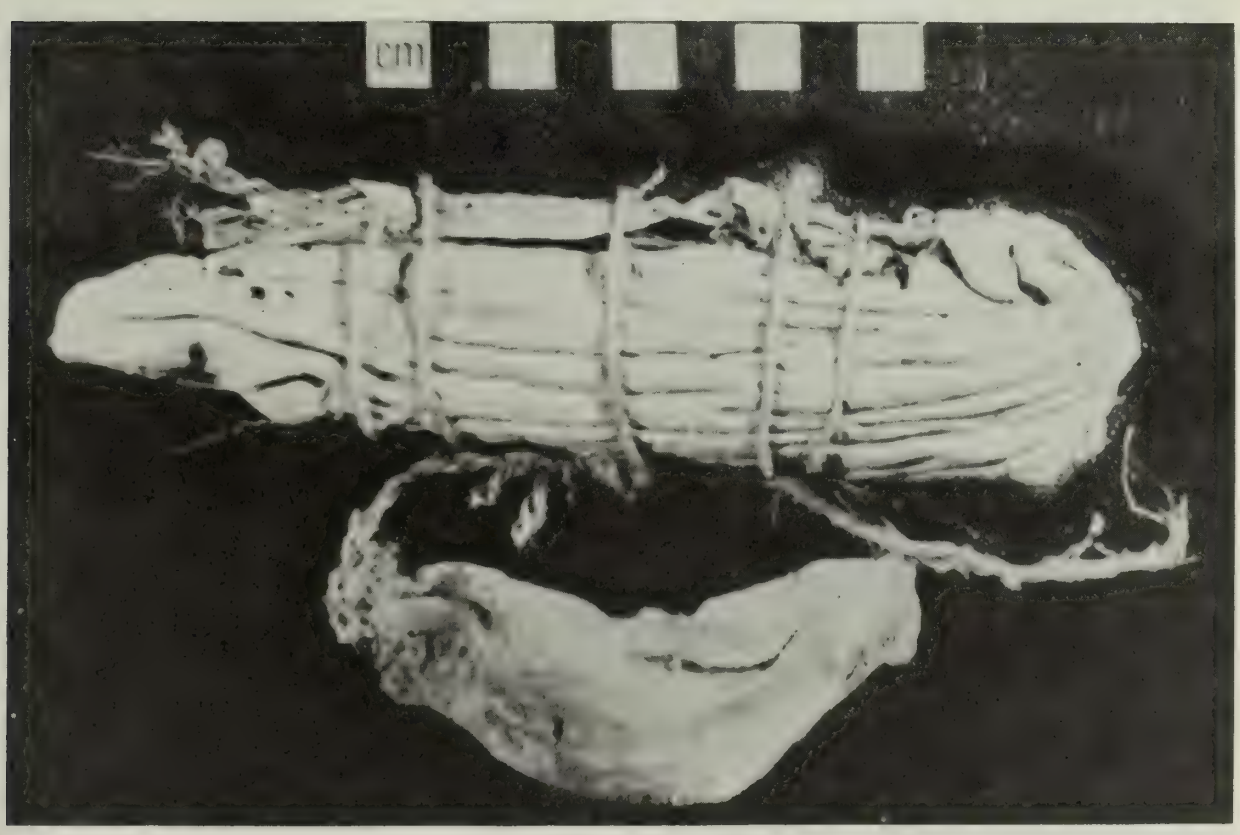


Figure 66. A plain weave cotton bag and hide bundle.

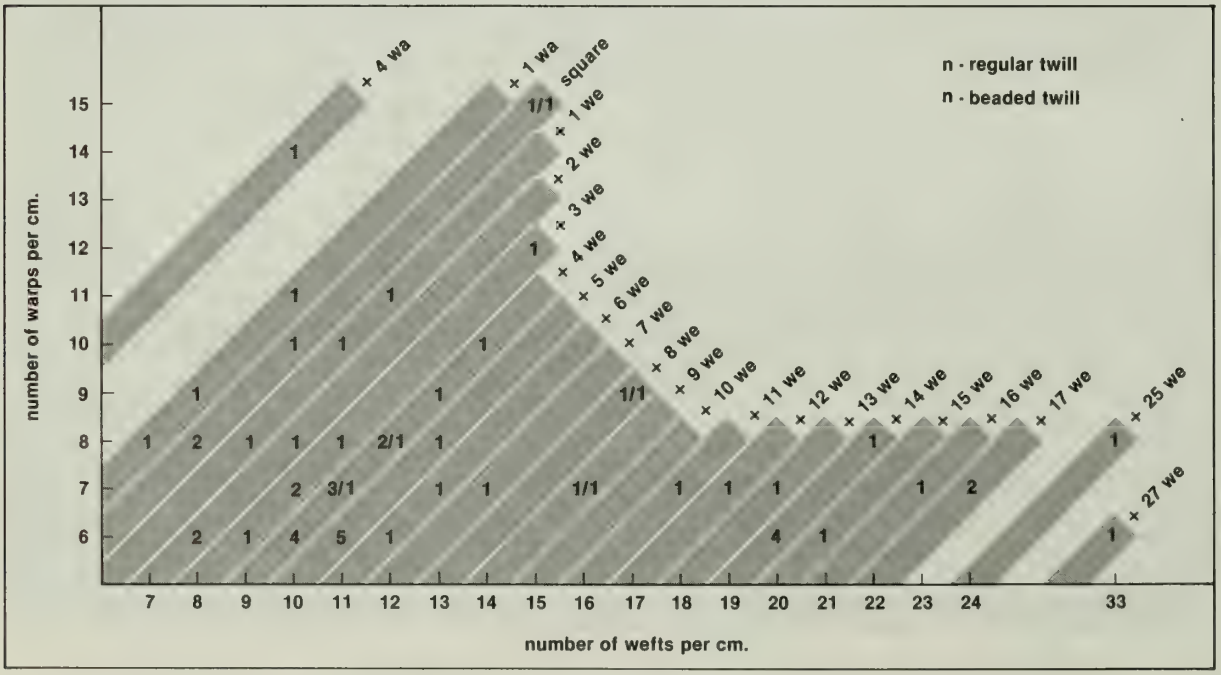
Twill Weave.

There are 36 specimens (totaling 0.314 m^2)of twill weave created by regularly floating wefts over two or more warps (Kent 1957: 535). Of these, 21 are plain twill, in which the ribs slant across the fabric in one direction; 11 are reversed twill, in which the diagonal ribs reverse direction at regular intervals to form vertical zigzags; and three are diamond twill, in which the zigzagging ribs converge to form diamonds (Kent 1957: 535–536). One specimen combines plain and diamond twill. There are five instances of twills in combination with plain weave and tapestry. These will be discussed below. Thirty-three of the twill textiles are dated: six to Middle PIII and 27 to Late PIII. The original function of none is recognizable, but one was reused as a sandal pad (Fig. 67) and three are patched onto other fabrics.

Figure 67. Sandals from Antelope House. Twill weave fabric reused as a sandal pad is seen in place in the second sandal from left.



Figure 68. Distribution of thread counts in twill weave fabrics from Antelope House.



Warps and wefts are single-ply Z-spun cotton, with the exception of one reversed twill with 2-ply Z-spun S-twist yarns. Thread count is most commonly weft predominant (80 percent), but 10 percent are square and 10 percent are warp predominant. The modal thread count is eight warps and 11 wefts per cm; 64 percent fall within ± 2 of this mode. Thread counts range from +4 WA to +9 WE. Beaded weft bands are commonly weft predominant, ranging from square to +27 WE, with weft counts between 11 and 33 per cm. The distribution of thread counts is graphed in Figure 68. For plain twill, weaving rhythm is 2/1 (over two under one) in 17 cases, 2/2 in four cases, and 2/4 in one case. Reversed twill is 2/1 in five specimens, 2/2 in four specimens, and 4/4 in two specimens. Diamond twill consists of three cases of 2/2. The combination plain and diamond twill textile is 2/1 rhythm in the plain twill sections and 2/5 in the diamond twill portion. All of the above figures relating to warp and weft characteristics, thread counts and rhythm include the multiple weaving technique specimens. The following discussion of decoration relates only to simple twill specimens.

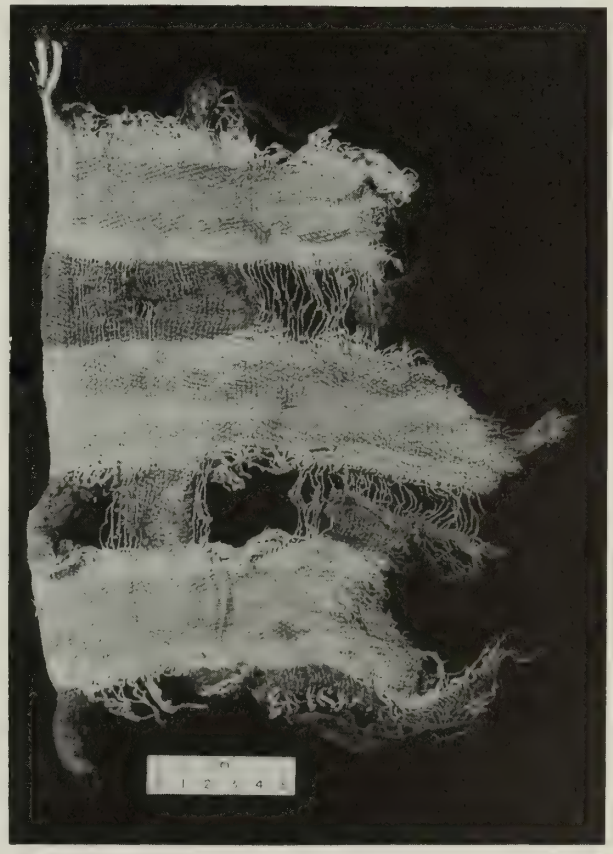
All warps are undyed. Wefts vary in coloring; 12 percent are natural, 7 percent are dyed red, 19 percent are natural and dyed brown, 21 percent are natural and dyed red, and 40 percent are natural and dyed brown and red. All of the plain twill, with the exception of two specimens with red-dyed wefts, have decoration in addition to the purely structural diagonal ribs. Weft bands with beading are found on 10 of the plain twill specimens and plain bands are found on two specimens. Weft stripes are present on six textiles and one specimen has alternating weft colors forming diagonal lines of color along the ribbing. Seven of the reversed twill samples have beaded bands and one has weft stripes. Three specimens have only the structural zigzags and lack dyed wefts. One diamond twill has only the structural diamonds in natural cotton and one has weft stripes running through the diamonds. One specimen has a central section utilizing all brown wefts, in which the structural diamonds are completed. This is bounded above and below by sections in which the diamonds are incomplete and which possess weft stripes in natural, red and brown. The specimen combining plain and diamond twill has weft bands and beaded weft bands in the plain section and alternating natural and brown wefts in the diamond twill section. The striped and banded twills utilizing red, brown and natural wefts are called Anasazi stripe twills (Kent 1957: 563). Figure 69 shows the most complete Anasazi twill specimen, the textile fragment used as a sandal pad. Figure 70 illustrates the major variations in twill decoration.

Six twill specimens have twined weft selvages and two have overcast weft selvages. There is one instance each of a twined and an overcast warp selvage. Selvage yarn characteristics are summarized in Table 98. There are two cases of twined stitching or embroidery, one of which reinforces a twined warp selvage. Stitching yarn characteristics are presented in Table 97.

Tapestry.

Interlocking tapestry is a technique in which no weft passes from edge to edge of the web; each weft is woven back and forth over a limited number of warps. Wefts loop around each other at points of contact (Kent 1957: 519). Wefts char-

Figure 69. An Anasazi twill fragment reused as a sandal pad; design is natural, brown and red bands and beaded bands.



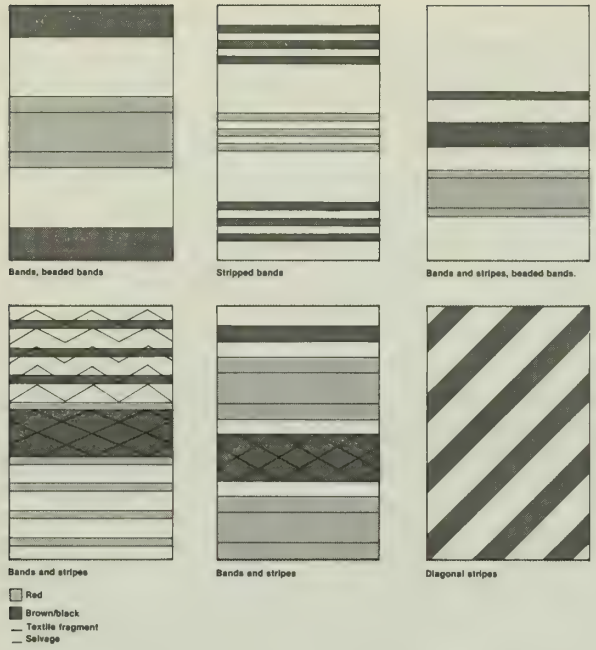


Figure 70. Major variations in decorative designs on twill weave fabrics from Antelope House.

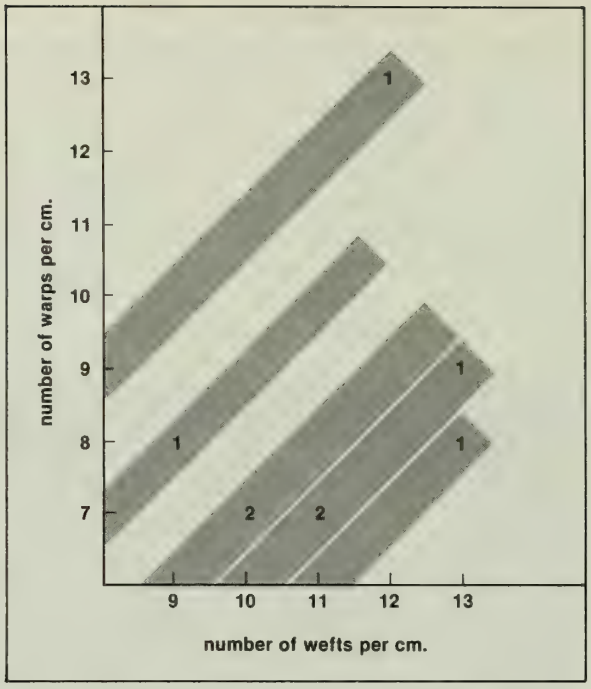


Figure 71. Distribution of thread counts in tapestry weave fabrics from Antelope House.

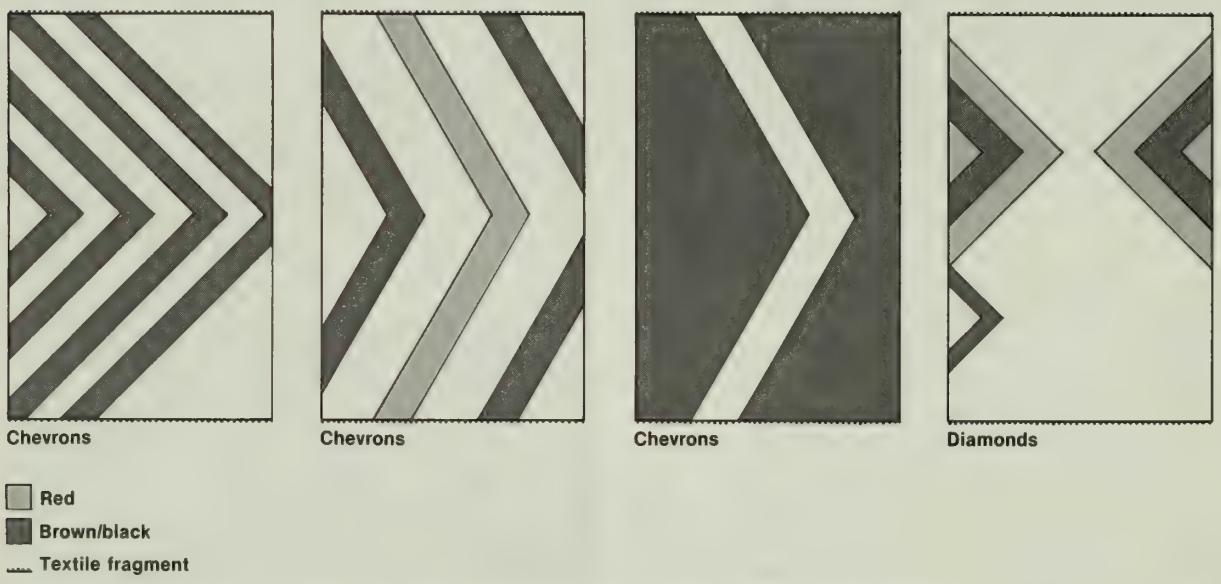


Figure 72. Variations in decorative designs on tapestry weave fabrics from Antelope House.

acteristically are battened together closely, so that the warps are completely obscured. Four interlocking tapestry textiles (totaling 0.021 m^2 of cloth) were recovered. Two are Late PIII and one is Early PIII. Four multiple technique specimens include tapestry.

Warps and wefts are single-ply Z-spun cotton. Warp diameters range from 0.5 mm to 0.7 mm and weft diameters from 1.0 mm to 1.5 mm. Warp counts are between seven and 13 per cm, with a mean of eight, while weft counts are between nine and 13 per cm, with a mean of 11. Thread counts are mostly weft predominant, ranging from +1 WA to +5 WE (see Table 96 and Fig. 71).

All warps are natural in color. Blocks of brown and natural wefts form chevrons on two specimens. A third specimen possesses chevrons

in brown, red and natural. Diamonds in brown and red on a natural background create the decorative motif on a fourth. These tapestry designs are illustrated in Figure 72. The designs on the multiple technique specimens are discussed below. Three tapestry specimens have twined warp selvages. Table 98 summarizes selvage yarn characteristics. None of the tapestry specimens is mended.

Multiple Technique Textiles.

Nine Late PIII textiles (totaling 0.282 m^2) combine plain and twill or tapestry weaves. Three textiles combine weft-face plain weave and plain twill. Two of these are sewn together; the third fragment, possessing two plain twill patches and three plain weave patches, probably was at one time attached to the other two fragments. The original artifact was probably a multi-patched blanket. Warps are all natural single-ply Z-spun cotton measuring 0.5 mm in diameter. Wefts are single-ply Z-spun cotton, measuring from 1.0 mm to 1.2 mm in diameter. Weaving rhythm in the twills in 2/1. The wefts are natural in the plain weave, but brown and natural wefts create a brown stripe and band motif in the twill portion of two specimens. The third textile has the brown stripe and band, plus a red band with natural beading. Thread counts are +7 WE for the plain weave and +6 WE for the twill (six warps to 13 and 12 wefts per cm, respectively) on two specimens. The beaded textile has +4 WE thread count (seven warps to 11 wefts per cm) and +6 WE (seven warps to 13 wefts) in the twill sections, increasing to +13 WE (seven warps to 20 wefts) in the beaded portion. One of the fragments has twined stitching below a twined warp selvage (see Tables 97 and 98). A plain weave band adjacent to the warp selvage in a twill specimen seems to have been common in Antelope House textiles.

One textile combines regular plain weave and plain twill. Warps and wefts are single-ply Z-spun cotton, with warp diameters of 0.7 mm and weft diameters of 1.0 mm. Twill rhythm is 2/2. Warps and wefts are natural in color, the only design being the structural ribbing in the twill. Thread count is square (eight yarns per cm) in the plain weave and +4 WE (eight warps to 12 wefts) in the twill.

Plain weave and diamond twill are combined in one specimen, with designs confined to the structural diamonds in the twill. The warps and wefts are natural single-ply Z-spun cotton. Warp diameter is 0.5 mm and weft diameter is 1.2 mm. Thread count is square (eight yarns per cm) in the plain weave and +3 WE (eight warps to 11 wefts) in the twill.

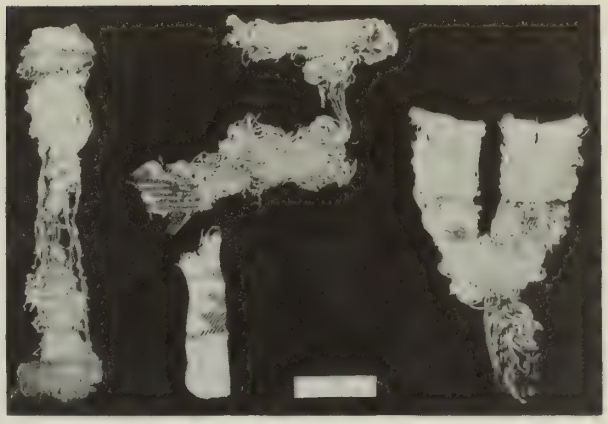


Figure 73. Multiple technique loom weaves: (clockwise from top center) two examples of plain weave and interlocking irregular twill tapestry, a plain weave and interlocking reversed twill tapestry bag and an example of plain twill, irregular twill and irregular twill tapestry.

A bag 12 cm long and 3.4 cm wide combines plain weave and interlocking reversed twill tapestry. Warps and wefts are single-ply Z-spun cotton, with a diameter of 0.5 mm for warps and 1.0 mm for wefts. The plain weave section uses only natural wefts, but the tapestry possesses natural, red and brown wefts forming parallelograms (Fig. 73). Thread count is +1 WA (13 warps to 12 wefts per cm) throughout the specimen. Rhythm in the tapestry is 2/2. The bag was made of a piece of cloth folded and sewed up the side and across the end with twined stitching, using natural 2-ply Z-spun S-twist cotton yarns. The bottom section consists of 4.5 cm of plain weave; the upper portion is the designed tapestry. The bag contained *Cleome* sp. (Rocky Mountain bee plant) seeds when discovered.

Plain weave and interlocking irregular twill tapestry are combined in two specimens. The warps and wefts are single-ply Z-spun cotton, with warp diameters of 0.5 mm and weft diameters of 1.0 mm. In one specimen, the weaving rhythm in the tapestry is 2/1. Brown wefts alternate with natural wefts to form chevrons in the tapestry portion (see Fig. 72). Thread count in the plain weave section is +4 WE (seven warps to 11 wefts) and in the tapestry is +3 WE (seven

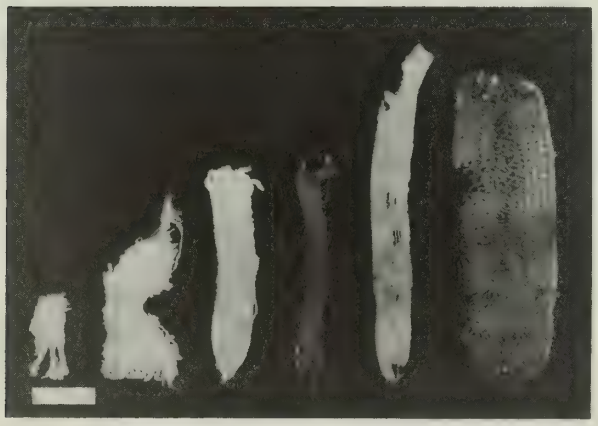
warps to 10 wefts). There is an overcast warp selvage adjacent to the plain weave portion. The other plain weave and tapestry specimen has a thread count of +1 WA (seven warps to eight wefts per cm). Weaving rhythm is 2/2 in the tapestry. Wefts are natural in the plain weave, but alternate between natural and brown in the tapestry to form diamonds (Fig. 73). The textile is repaired with 2-ply cotton yarns in a 3/3 multiple yarn plain weave technique, but the repaired section originally was part of the tapestry.

The most complicated specimen involves plain twill, irregular twill and irregular twill tapestry. Warps and wefts are single-ply Z-spun cotton, with a warp diameter of 0.7 mm and a weft diameter of 1.0 mm. Weaving rhythm is 2/1 for the plain twill and the twill tapestry, 2/4 for the irregular twill. Thread count is +4 WE (seven warps to 11 wefts per cm) throughout. Brown and natural wefts in the irregular twill and tapestry form diagonal stripes along the ribbing in the twill and diamonds in the tapestry. The irregular twill section is repaired with 2-ply cotton yarns in a plain weave technique. Above and below the irregular twill and tapestry sections are plain twill sections with natural and red bands and natural beading (see Fig. 73).

Non-Loom Textiles: Descriptions

Six weaving techniques at Antelope House do not make use of the loom: flat braid, warp-face plain weave, tapestry, weft-twine, looping and weft-wrap. There are 111 specimens of non-loom weave (totaling 9.7 m^2), half of which come from dated Anasazi proveniences (five from P1, 19 from PII, 12 from EPIII, 10 from MPIII and 59 from LPIII). Figure 74 and 75 show non-loom woven textiles and their raw materials.

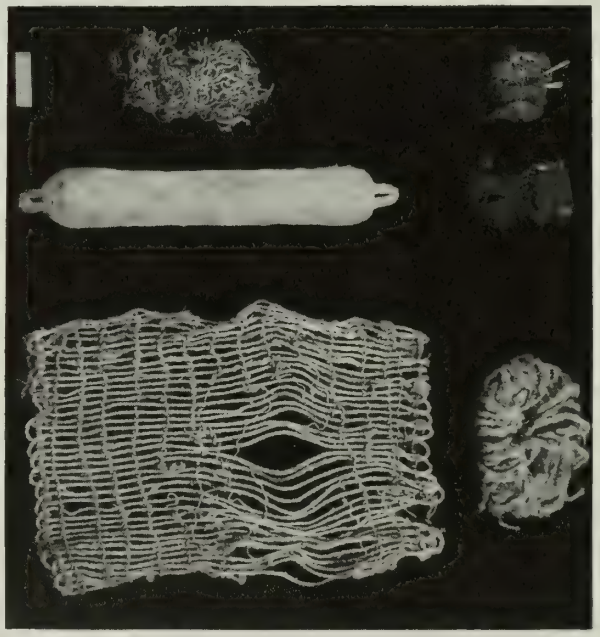
Figure 74. Non-loom woven textiles: (from left) two framebraided cotton fragments, a braided cotton tumpline, a braided wool fragment, a weft-twined yucca tumpline and a weft-wrapped human hair and yucca tumpline.



Flat Braid.

Flat braid, in which each yarn passes diagonally over and under its fellow from one side of the fabric to the other (Kent 1957: 593), is represented by 36 specimens, totaling about 1.3 m^2 of cloth. Braided textiles from Anasazi proveniences include three from PII and 29 from Late PIII. Most specimens appear to be bands or sashes, but two are tumplines and one is a cradle band. Two of the braided bands are complete; these measure 25 cm by 2.1 cm and 66 cm by 2.5 cm. The longer one ends in square braided fringe and the shorter one ends in a V-shape. Three Latė PIII bands have straight ends rather than the characteristic V-shaped ends (see Fig. 74), suggesting that they may have been manufactured on a frame of some kind (Kent 1974: per-

Figure 75. Yucca and hair textiles and raw materials: (clockwise from top left) a human hair yarn bundle and **Acer negundo** *needles, a looped bag of human hair yarn, a feathered-wrapped* **Yucca baccata** *cord bundle, a feather-wrapped cord (***Yucca** *sp.) weft-twined robe,* **Yucca** *sp. weft-twined tumpline and a* **Yucca** *sp. cord bundle.*



sonal communication). The frame used would not necessarily be the kind used by the Hopi today for the woman's wedding belt; it would simply require that the warps be secured at both ends. The only other frame-braided textiles yet identified in a prehistoric puebloan context are two specimens from Inscription House (Kent 1973: 13). The two tumplines are Late PIII and measure 90 cm by 4.5 cm and 20 cm by 3.9 cm. The latter tumpline is fragmentary. The Late PIII cradle band consists of two textile fragments knotted to a 13-cm long rod. The textile is too badly deteriorated to tell much about the original cradle band.

Yarns in braided textiles are 2-ply Z-spun S-twist cotton. Diameters range from 0.5 mm to 2.0 mm, with a mean of 1.4 mm. Rhythm is consistently 2/2. Braiding yarns normally are plain white. One specimen, however, has a zigzag pattern created by the occasional use of brown-dyed yarns, due to the structural character of braiding.

Ends on flat braid consist of either a V-shaped self selvage or square braided fringe. The square braid ranges from six to 12 strands, with eight being the mode. One textile has cotton yarns overcast along the edge for reinforcement.

Warp-Face Plain Weave.

Plain weave in which the number of warps greatly exceeds the number of wefts per cm and in which the warps conceal the wefts is called warp-face (Kent 1957: 529). Warp-face textiles characteristically are narrow bands and ties. According to Kent (1957: 533), warp-face non-cotton bands were made by the Anasazi, but warp-face cotton fabrics were confied to the Sinagua, Salado and Hohokam before AD 1500. The non-cotton bands were made by looping a skein of warps about two supports and inserting wefts, which continuously turn about the edge warps and re-enter the weave. There are three pieces of warp-face textile from Antelope House. One PIII tumpline (3 cm wide and 40 cm long) has warps and wefts of 2-ply Z-spun S-twist fine *Yucca* sp. fiber, with six warps and three wefts per cm. One end has the original end loop for attaching a burden to the tumpline. The other end, however, is fragmentary and has been crudely repaired with irregular running stitches. The use-life of the tumpline was extended by knotting *Yucca* sp. cords (one of them feather-wrapped) about the ends of the tumpline as a means of attaching burdens. A narrow band fragment from Early PIII also is warp-face. The band is unusual for an Anasazi site, in that the wefts and some of the warps are cotton. All warps and wefts are 2-ply Z-spun S-twist. The non-cotton warps are fine *Yucca* sp. fiber. The cotton warps are on the edges of the specimen, while the yucca warps form a medial band. There are 11 warps and three wefts per cm.

The third warp-face specimen is a PII belt (2 m long and 3.6 cm wide), which was found neatly rolled into a coil and secured by knotting two elements of its braided fringe. This belt consists of a medial band of warp-face plain weave, flanked on either edge by flat braiding. The yarns used in the edge braiding are 2-ply Z-spun S-twist cotton. The warps in the warp-face plain weave are 2-ply Z-spun S-twist white and brown hair and brown-dyed cotton. The cotton yarns used in the braid form the wefts in the warp-face section. Most of the braiding yarns are white, but occasional brown yarns create brown zigzags down the belt. The warp-face section has narrow brown stripes on a white background. On the ends are fringes of square braid ending in round pompom tassels.

Tapestry.

Four non-loom tapestry specimens were identified. There are three specimens (totaling 423 cm) of slit tapestry. In this weaving technique, discontinuous wefts do not interlock, leaving vertical slits in the fabric (Kent 1957: 518). One Early PIII specimen of indeterminate function has 2-ply Z-spun S-twist coarse *Yucca* sp. fiber warps (2.0 mm diameter) and 1 and 2-ply z-spun S-twist human hair wefts (1.0 mm diameter). Thread count is five warps and 10 wefts per cm. The tapestry design is uncertain, due to the fragmentary nature of the specimen, but it utilizes brown and white hair wefts. A Late PIII tumpline has 2-ply S-spun Z-twist coarse *Yucca* sp. fiber warps (2.0 mm diameter) and single-ply Z-spun undyed cotton wefts (1.5 mm diameter). Thread count is three warps and 10 wefts per cm. The tumpline is covered with pitch so that the tapestry design is not discernible. A Middle PIII apron has a tapestry band with fringe. The apron has coarse *Yucca* sp. fiber warps, which are 2-ply S-spun Z-twist (2.0 mm diameter). The wefts are fine *Yucca* sp. fiber, 2-ply S-spun Z-

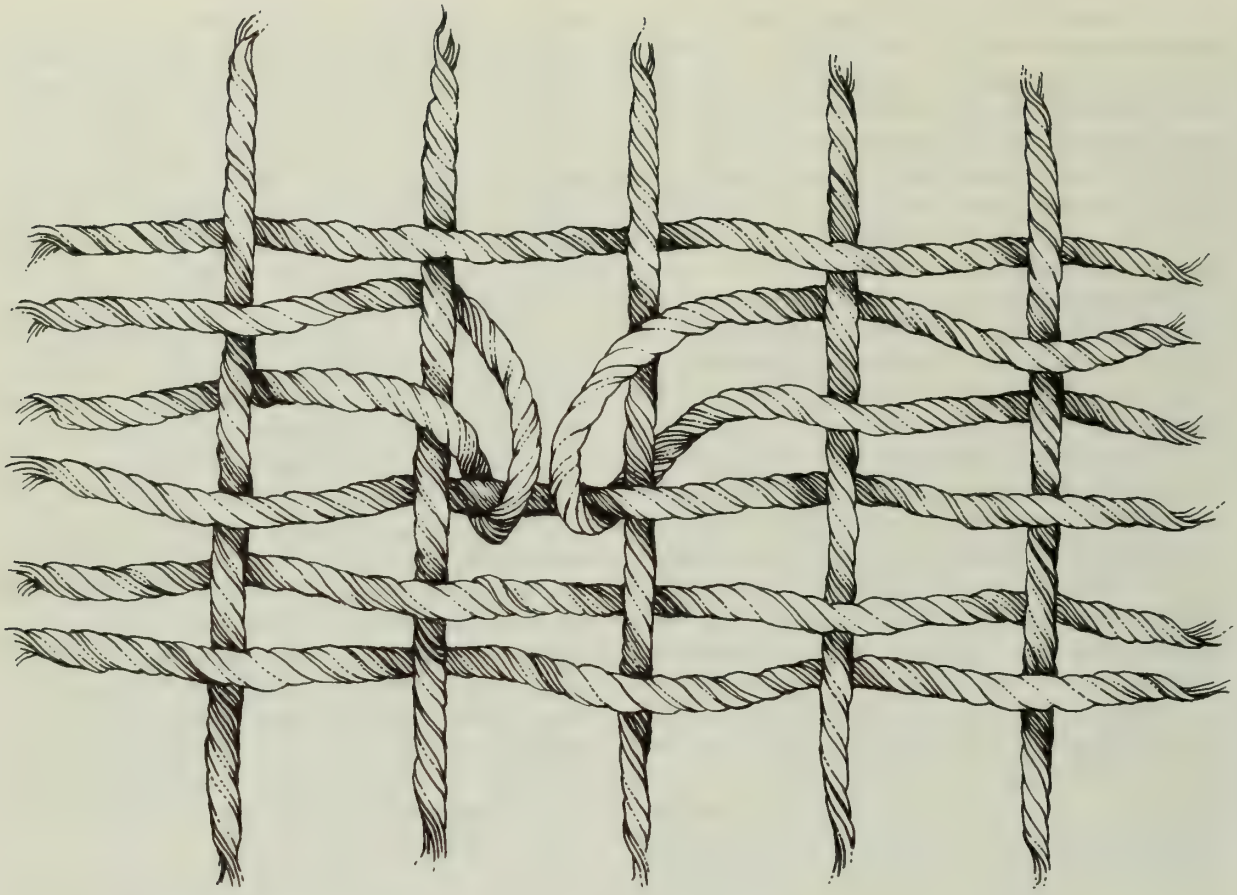


Figure 76. Interlocking tapestry technique from an Early PIII cradle band.

twist (1.5 mm diameter). Triangular motifs are formed by the use of 2-ply Z-spun S-twist brown-dyed cotton and brown and white human hair wefts along one edge above the fringe of extended wefts. There are four warps per cm, but the wefts per cm vary with the material. The yucca wefts run six per cm, the hair wefts run seven per cm and the cotton wefts run 11 per cm.

An Early PIII interlocking tapestry cradle band is the fourth non-loom tapestry from Antelope House. The interlocking is unusual, in that the weft appears to wrap around a parallel weft rather than around the weft of another color it replaces to create the design (Fig. 76). The cradle band is 26 cm long and 17 cm wide. It was found in place on a cradle in a child burial (Fig. 77). The warps are 2-ply S-spun Z-twist coarse *Yucca* sp. fiber and the wefts are 2-ply Z-spun S-twist cotton. Weaving rhythm is 2/2 and thread count is +2 WA (seven warps to five wefts per cm). Checked and striped patterns are created by using natural and brown-dyed wefts. The design consists of five warp-wise rows of three rectangles, with alternating vertical stripes or checks. The warp ends are looped with 2-ply Z-spun S-twist cotton yarns, which are wrapped over rods. Other cotton yarns twine through these looped yarns to secure the wrapping.

Looping.

Looping, a technique in which each yarn is crossed on itself after encircling the loop about it (Kent 1957: 587), is represented by 42 specimens, totaling 4.5 m^2 of cloth. Thirty-eight of these specimens are from dated Anasazi proveniences (five from PI, 14 from PII, eight from EPIII, three from MPIII and eight from LPIII).

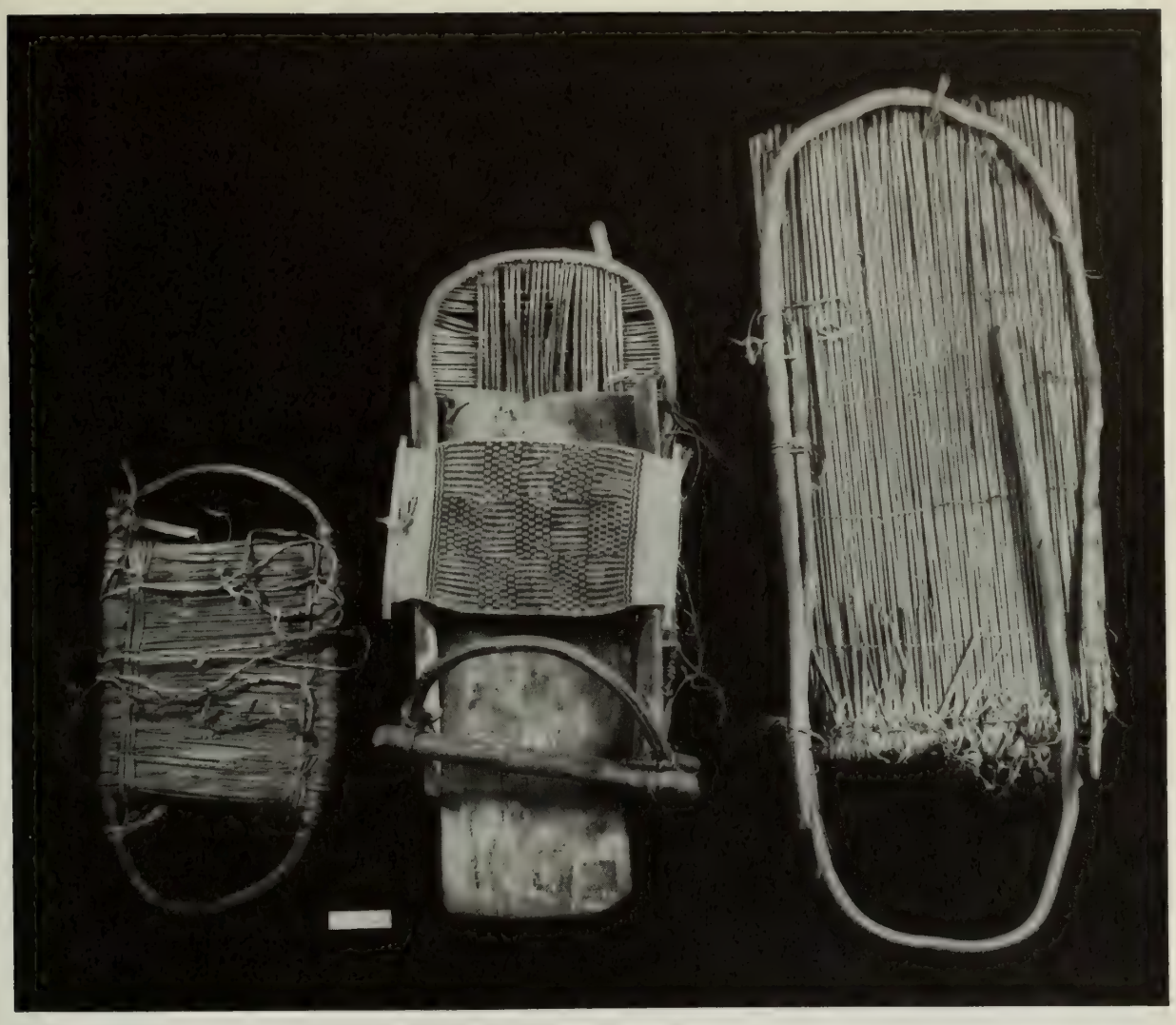


Figure 77. Bent frame cradles from Antelope House.

Identifiable looped artifacts include two bags and seven socks. One of the bags is Early PIII and is made of feather-wrapped yucca. This bag is crudely sewn with *Yucca angustissima* twined stitches. It measures 20 cm by 13 cm. An undated human hair bag fragment, measuring 12 cm by 8 cm, is sewn together with saddler's stitches in yucca. These bags could be recycled socks, as suggested by Dixon (1956: 27). The seven sock fragments include six of human hair (three from PI and two from PII); the undated hair sock has the top selvage done in yucca. Two socks are mended with yucca, using running and saddler's stitches. These fragments are small, the largest measuring 25 cm by 22 cm. The seventh sock fragment is made of yucca wrapped with feathers and dates to Middle PIII. The yarns are predominantly 2-ply Z-spun S-twist human hair (55 percent), but 14 percent are coarse *Yucca* sp. fiber; 12 percent are fine *Yucca* sp. fiber; and 10 percent are feather-wrapped *Yucca* sp. fiber (three fine and one coarse). Fine yucca yarns are 50 percent 2-ply Z-spun S-twist and 50 percent 2-ply S-spun Z-twist. Coarse yucca yarns are 67 percent S-spun Z-twist and 33 percent Z-spun S-twist; all are 2-ply. Five specimens have unique yarns: one is made with sinew strips; one has both fine *Yucca* sp. fiber and human hair yarns; one has hair-pile

cotton yarns; one has fine yucca yarns (2-replied Z-twist); and one has coarse yucca yarns (2-replied S-twist). The use of hair rather than yucca in looping does not appear to have temporal significance.

Hair yarns range in diameter from 0.5 mm to 2.0 mm, with a mean of 1.5 mm. Fine yucca yarns range from 1.0 mm to 2.0 mm in diameter, with a mean of 1.5 mm. Coarse yucca yarns range from 1.0 mm to 2.5 mm in diameter, with a mean of 1.7 mm. Looped fabrics generally are undecorated, but a decorative effect is produced in one specimen through the use of three different natural shades of yucca.

Weft-Twine.

Weft-twine is a technique in which pairs of wefts clasp one or more warps and make a half turn about each other (Kent 1957: 583). There are 11 weft-twine fur and/or feather robes, constituting 2.85 m^2 of fabric. These robes are made by spaced weft-twining, in which groups of twining elements are spaced to produce a net-like effect (Emery 1966: 201). There are 13 compact weft-twine specimens (totaling 0.8 m^2), in which a weft-face appearance is created by tightly spacing the wefts. Compact and spaced weft-twine specimens are pictured in Figure 74 and 75.

The compact weft-twine textiles include six Late PIII specimens, one Middle PIII, one Early PIII and one PIII. Identifiable objects include five tumplines, one of which is complete with end loops. This tumpline is 44 cm long and 7 cm wide. The other weft-twine specimens appear to be bands or tumplines. Seven specimens have yucca warps and cotton wefts; three have yucca warps and wefts; two have cotton warps and wefts and one has hair warps and cotton wefts. The yucca elements generally are 2-ply Z-spun S-twist. There is, however, one instance each of single-ply S-spun and 3-ply S-spun Z-twist. Yucca element diameters range from 1.0 mm to 2.0 mm, with a mean of 1.6 mm. The cotton elements are all 2-ply Z-spun S-twist with diameters of 1.0 mm to 2.0 mm (mean = 1.2 mm). The single instance of hair warps involves unspun elements 3.0 mm in diameter. Thread counts for compact weft-twines range from three to seven warps (mean = 4) and from seven to 19 wefts (mean = 11). Thread counts are weft-predominant between +3 WE and +16 WE. Weaving rhythm is 1/1, except in one case of 2/2 and one in which 10 warps are loosely grouped together to produce a 10/10 rhythm.

The robes were constructed by weft-twining yucca cords about warps wound with strips of rabbit fur or turkey feathers. Five specimens were made completely of turkey feathers (three from Middle PIII and two from Late PIII); three were made completely of rabbit fur (one from Late PIII); and three have a mixture of fur and feather warps (two from Middle PIII). All warps are 2-ply and all but one (which is coarse *Yucca* sp. fiber cord) are fine *Yucca* sp. fiber. Eight have S-spun Z-twist warps and two have Z-spun S-twist. The coarse fiber specimen is Z-spun S-twist 2-replied Z-twist. Warp diameters range from 2 mm to 8 mm, with a mean of 4 mm. The differences in warps do not correlate with the presence of fur versus feather. Wefts are fine *Yucca* sp., without fur or feather wrapping. Seven specimens have 2-ply S-spun Z-twist wefts and one has 2-ply Z-spun S-twist wefts. Weft diameters range from 2 mm to 5 mm, with a mean of 3 mm.

Weft selvages on robes are self, but warp selvages include a thick cord twined between the warps. Such warp selvage yarns are coarse *Yucca* sp fiber in two cases, fine *Yucca* sp. fiber in three cases, and *Salix* sp. and unidentified bark fiber in one case. Seven specimens are 2-ply S-spun Z-twist and two are 2-ply Z-spun S-twist. One of the Z-spun specimens is 2-replied S-twist. The differences in spin correlate with the spin of the warps and wefts. Diameters for these selvage cords range from 5 mm to 10 mm, with a mean of 7.5 mm. One complete robe, measuring 1.05 m by 0.9 m, gives some idea of the size of these robes. In addition to the fur and feather robe fragments, there are 2857 grams of feather-wrapped yucca cord, 484 grams of fur-wrapped yucca cord, 168 grams of fur and feather-wrapped yucca cord, and 26 grams of fur-wrapped unidentified bark cord, which may once have formed the warp elements of robes.

Weft-Wrap.

Two Late PIII tumplines are woven by the weft-wrap technique, in which each weft passes over two warps and wraps around one of them (Emery 1966: 215). This weaving technique should not be confused with the decorative technique known as weft-wrap openwork, since the warps are not pulled out of alignment to form decora-

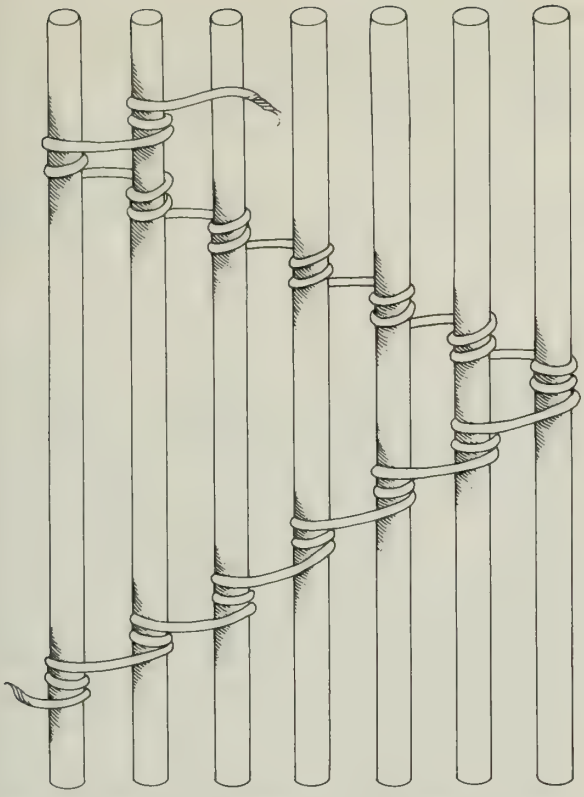


Figure 78. In the rare weft-wrap technique (not to be confused with weft-wrap openwork), each weft passes over two warps and wraps around one of them.

tive openwork. Weft-wrap is a rare technique. Two tumplines similar to the Antelope House specimens are reported by Haury (1945: 40–41) from Painted Cave. In Haury's specimens, however, wefts pass over and wrap each warp individually.

One tumpline consists of six doubled-back warps of four-strand yucca square braid. Wefts are 2-ply Z-spun S-twist human hair. The thread count is 1.25 warps and seven wefts per cm. The tumpline is 9.5 cm wide and 71 cm long. The central section, which rested against the forehead when the tumpline was in use, consists of 26 cm of weft-wrapping. It is flanked by 22-cm segments in which the warps are divided into two groups, which are then figure-8 wrapped with 2-ply S-spun Z-twist *Yucca* sp. cord. The last 8 cm are wrapped separately to produce an opening for securing the tumpline to the carrying basket. The second specimen consists of 2-ply S-spun Z-twist 2-replied S-twist coarse *Yucca* sp. fiber warps 2.0 mm in diameter. The wefts are 2-ply Z-spun S-twist human hair. The thread count is two warps and six wefts per cm. Only the central section is present. It is 27 cm long and 8.5 cm wide. Figure 75 and 78 illustrate the tumplines and the weft-wrapping technique.

Textile Variation

The most obvious variation in Antelope House textiles is that in weaving technique. Although plain weave is clearly dominant, comprising 88 percent of the total collection, the remaining 12 percent includes eight different weaving techniques (Table 99). Variation also exists in thread characteristics, selvages, stitches and decoration. These variations are discussed below in terms of covariation, as well as functional, temporal and spatial distributions, in order to identify possible elements of patterning. The Antelope House textiles also are compared with other Anasazi textiles.

Covariation of Textile Characteristics

Warp and weft materials are correlated with weaving techniques. All loom-woven textiles are cotton, as are flat braided specimens. Tapestry employs yucca warps, but wefts may be yucca, hair or cotton. Looping generally makes use of hair (55 percent of the cases), but yucca or feather-wrapped yucca threads also are used. Compact weft-twine is 65 percent yucca, but it also contains cotton and hair warps; wefts are of cotton (71 percent) or yucca. Weft-twined fur and feather robes are 100 percent yucca, although cordage specimens suggest that bark also was used as a twine material for fur robes. The weft-wrapped textiles have yucca warps and human hair wefts. Yucca, therefore, is the most common yarn material in non-loom weaves, especially for warps, but cotton and hair also are present.

Yarn spin varies significantly with material (Table 100). Z-spun is most common overall. Cotton and hair yarns all are Z-spun, as are 67 percent of the yucca fiber yarns. The remaining 33 percent of the yucca fiber yarns are S-spun.

Design technique and elements correlate significantly with weaving technique (Tables 100, 101). Weft-wrap openwork, brocade and painting are restricted to plain weave and all but two instances of embroidery (or selvage reinforcement)

Table 99. Weaving techniques at Antelope House.

Technique	*Number*	*Percent*	*Square meters*	*Percent*
Plain Weave	1129	87.6	156.64	93.82
1122 regular				
2 multiple warp				
5 weft-face				
Twill Weave	36	2.8	0.314	0.19
21 plain				
11 reversed				
3 diamond				
1 plain and diamond				
Interlocking Tapestry	4	0.3	0.021	0.01
Plain, Twill and Tapestry	9	0.7	0.282	0.17
5 plain weave and twill				
2 plain weave and tapestry				
1 twill and tapestry				
Flat Braid	36	2.8	1.3	0.78
Looping	42	3.3	4.5	2.70
Weft-twine	24	1.9	3.674	2.19
Tapestry (non-loom)	4	0.3	0.087	0.05
3 slit				
1 interlocking				
Weft-Face Plain Weave	3	0.2	0.085	0.05
2 regular				
1 weft-face and flat braid				
Weft-Wrap	2	0.2	0.074	0.04
Total N = 1289			Total m^2 = 166.95	

Table 100. Results of chi-square tests on textiles.

Null Hypothesis	*Result*
1. Variation in spin (S versus Z) of selvage, mending and patching yarns by material (hair, cotton, yucca) is due to chance.	P<.005
2. Variation in design technique and elements by weaving technique (plain, twill, tapestry weaves) is due to chance.	P<.005
3. Variation in the frequency of mending by weaving technique (plain, twill, tapestry and non-loom weaves) is due to chance.	P<.005
4. Variation in the frequency of patching by weaving technique (plain, twill, tapestry and non-loom weaves) is due to chance.	P<.005
5. Variation in yarn material (cotton, hair, yucca) by function in patching, mending, weft selvage or warp selvage is due to chance.	P<.05
6. Variation in yarn ply (1, 2, 3, 4, 5–7, reply) by function in patching, mending, embroidery, warp selvage or weft selvage is due to chance.	P<.005
7. Variation in selvage type (twined, overcast, self, over-cast-twined) by warp versus weft selvage is due to chance.	P<.05
8. Variation in stitch type (twined, overcast, running, saddler's, outline) by function in patching versus mending is due to chance.	P<.005
9. Variation in thread count (warp predominant, square or weft predominant) in plain weave by period (PI-LPIII) is due to chance.	P<.001
10. Variation in mending and patching yarn material (cotton versus yucca) over time is due to chance.	P<.005
11. Variation in plain weave thread count (warp predominant, square or weft predominant) by room block is due to chance.	P<.005

Table 101. Decorative techniques and elements by textile weaving technique.

	Plain Weave	*Twill Weave*	*Tapestry*
Embroidery and Brocade	56	2	0
Diamonds and Chevrons	0	0	7
Bands and Stripes	4	24	0
Diagonal Stripes	0	2	0

are found on plain weave. Bands and stripes characterize twills, while diamonds and chevrons are commonly found in tapestry. The only plain weave textiles with bands or stripes are weft-face and multiple warp specimens.

The presence or absence of mending and patching also varies significantly with weaving technique (Table 100). Mending is characteristic of 80 percent of the plain weave specimens, but only 7 percent of the twill and 29 percent of the tapestry specimens are mended. Seventy-nine percent of non-loom weaves are mended, but non-loom fabrics are not patched, although looped fragments do appear as patches on loom weaves. Plain weave exhibits the greatest amount of patching (14 percent). None of the tapestry and only 7 percent of the twill specimens are patched.

The non-metric Guttman-Lingoes series was used to analyze a matrix composed of similarity coefficients (lambda), expressing the relationships among 18 variables associated with plain weave textiles. These variables consisted of selvage types and stitches used in mending, patching and embroidery. The results indicated a tendency for certain variables to be associated. The following five clusters of variables are identifiable: Cluster 1—outline stitch (hemmed) edges and overcast stitch selvages and outline stitch patching; Cluster 2—saddler's stitch patching and mending; Cluster 3—overcast stitch patching and overcast selvages; Cluster 4—outline stitch (hemmed) edges, outline stitch and running stitch mending; and Cluster 5—self selvages and overcast stitch mending.

The clusters are distinct, with the exception of Clusters 1 and 2, which are closely associated. These clusters seem to indicate that certain behavioral patterns in mending, patching and selvages tended to be associated with one another. Preferences for overcasting or other types of stitches were carried across functional categories (i.e., the use of overcasting for patching and selvages), despite the functional correlations also demonstrable in the data.

Functional Variation

Despite the fragmentary nature of most textiles, it was possible to discern certain correlations between function and weaving technique. The non-loom weaves are more functionally identifiable than are the loom weaves. Socks and bags are looped. Tumplines are diverse, employing flat braid, weft-wrap, weft-twine and tapestry. Belts and sashes are flat braid and warp-face plain weave. Apron bands are tapestry and fur-feather robes are weft-twined.

The functions of the various loom weaves are less certain. Only 13 identifiable objects are present among the 1178 loom-woven specimens. Plain weave is found in bags, loincloths and blankets. No twill specimens can be identified as to function, and only one tapestry weave, a bag, is identifiable.

Yarn characteristics and selvage types proved to be keyed to function. Yarn material varies significantly, depending upon its function as part of warp selvage, weft selvage, patching or mending (Table 100). Cotton is the dominant overall yarn material (96 percent). Fifty percent of all yucca yarns were used in mending, but they are found in only one warp selvage and in that case the yarn is a hair-pile.

Yarn ply also is tied to function (Table 100). Two-ply is the most common for all yarn functions (73 percent). Single-ply is rare, except in design yarns, where it is found in 43 percent of the cases. Multi-ply (more than two) yarns are most characteristic of selvages. Seventy-three percent of multi-ply yarns are found in selvages. Selvage types vary significantly according to their presence at warp versus weft edges (Table 100). Twining predominates on warp selvages (46 percent) and overcasting on weft selvages (48 percent).

The type of stitch is determined largely by the functional requirements of patching or mending (Table 100). Twined stitching overwhelmingly predominates as a mending stitch (92 percent), whereas it is the least common (3 percent) of the main stitches used in patching. The favored patching stitch is overcasting (59 percent), with running stitch coming second (25 percent).

Temporal Variation in Textiles

Frequencies of the various weaving techniques change over time (Table 102). The most obvious variation is in the relative proportions of loom and non-loom fabrics. Non-loom techniques constitute 37 percent of the total textile collection during PI and PIII times; but during Late PIII, they drop to 6 percent. Looping is primarily responsible for the large proportion of non-loom weaves in earlier times, since 50 percent of looped fabrics date from PI and PII. Braid is pecularily distributed, in that 90 percent of the braid specimens are Late PIII and 10 percent are PII; there are no Early or Middle PIII braids. This probably is due to sampling error.

Plain weave thread count varies significantly over time (Tables 100, 103). Pueblo I and II plain weave is 85 percent warp predominant. In 59 percent of the cases during that period warp predominance is at least +2 WA. Warp predominant fabrics then decrease, until in Late PIII they represent 56 percent of the collection, only 31 percent being +2 WA or more. Square thread counts become more common during Late PIII, when they characterize 27 percent of the plain weave textiles, as opposed to 13 percent during PI and PII. Weft predominant textiles steadily increase from 3 percent of the PI and PII specimens to 18 percent of the Late PIII plain weave textiles.

Dendrochronological climatic reconstruction and a study of unmodified vegetal trash from Antelope House suggest climatic stress in Middle PIII times (see Chapter 10). It was hypothesized that environmental stress should decrease the capacity for growing cotton, thereby decreasing the amount of cotton available for use in textiles, but textiles of cotton outnumber textiles of yucca and hair throughout the sequence. Cotton textiles constitute 71 percent of the total collection, while hair makes up 17 percent and yucca 9 percent. Table 104 shows the relative proportions of these three materials over time. Numerically, cotton textiles steadily increase from 44 percent to 98 percent, except for a slight decrease in Early PIII. When square meters of cloth are considered, however, there is a dip in Middle PIII, whereas Early PIII exhibits the highest percentage of cotton (98.9 percent). Even in Middle PIII, 92.2 percent of the textiles are cotton and only 7.8 percent are yucca. By Late PIII the percentage of cotton textiles had climbed again to 97.7 percent. This slight dip in the proportion of cotton during Middle PIII provides little support for the notion of decreased cotton availability. Examination of the gross proportions of the various textile materials is complicated by the demonstrated correspondence between yarn material and weaving technique and by the differential purposes for which the various weaving techniques were used.

The hypothesized decrease in available cotton should show up more clearly in contexts where readily available substitutes existed. One such context is patching and mending. A chi-square test (Table 100) demonstrates that materials used for patching and mending threads change significantly through time. The character of changes, however, is contrary to that expected. Prior to Middle PIII, yucca dominated cotton, accounting for 71 percent of the threads. In Late PIII times, cotton was the most common thread (96 percent). During Middle PIII, when cotton should have been scarce, it accounts for 97 percent of the threads. Examination of the cordage from Antelope House shows a slight decrease in cotton cordage during Middle PIII; Early PIII cordage is 2.5 percent cotton and Late PIII cordage is 6.2 percent cotton, while Middle PIII cordage is 1.9 percent cotton.

Table 102. Textile weaving techniques, by period.

	P I-II	*EP III*	*MP III*	*LP III*
Plain Weave	41	29	93	811
Twill Weave	0	0	6	33
Tapestry (loom)	0	1	0	5
Braid	3	0	0	29
Weft-twined	1	1	6	12
Looped	19	8	3	8

Table 103. Plain weave thread counts, by period.

	P I-II	*EP III*	*MP III*	*LP III*
+5 to 9 WA	2	2	4	16
+4 WA	2	5	8	33
+3 WA	4	2	10	62
+2 WA	15	5	13	130
+1 WA	10	8	32	197
Square	5	1	22	210
+1 WE	0	2	9	89
+2 WE	0	0	3	23
+3 to 9 WE	1	1	1	26

Table 104. Textile materials over time.

	Square Meters	*Percent*	*Number of Specimens*	*Percent*
Pueblo I				
cotton	0.017	28.8	4	44.4
yucca	0.036	61.2	2	22.2
hair	0.006	10.0	3	33.3
Total m^2 =	0.059		Total N = 9	
Pueblo II				
cotton	1.312	92.5	42	80.8
yucca	0.022	1.5	4	7.7
hair	0.084	5.9	6	11.6
Total m^2 =	1.418		Total N = 52	
Early Pueblo III				
cotton	2.055	98.8	32	74.4
yucca	0.020	1.0	7	16.3
hair	0.005	0.2	4	9.3
Total m^2 =	2.080		Total N = 43	
Middle Pueblo III				
cotton	33.627	92.2	101	94.4
yucca	2.846	7.8	5	4.7
hair	0.0002	0.1	1	0.9
Total m^2 =	36.4732		Total N = 107	
Late Pueblo III				
cotton	92.492	97.7	878	98.1
yucca	1.694	1.8	9	1.0
hair	0.508	0.5	8	0.9
Total m^2 =	94.694		Total N = 895	

In a situation of cotton scarcity, attempts to increase the use-life of textiles should be more common. About 13 percent of all Antelope House textiles are mended and/or patched. When only textiles at least 100 cm^2 are considered, the proportion increases to 47 percent. Mending shows a slight increase in Middle PIII; 17 percent of Middle PIII textiles are mended, compared to 13 percent of Early PIII and 10 percent of Late PIII textiles. Despite this small variation and contrary to expectations, the overall quantity of mending and patching remains proportionately constant throughout the sequence.

Thus the hypothesis is only weakly supported: the findings suggest that cotton did not decrease significantly in availability during Middle PIII. The hypothesized decrease in cotton during times of stress is based largely on the notion that cotton is a non-food crop and is, therefore, more likely to be considered less essential for survival. Research has shown this assumption to be falacious. Fecal analysis reveals that cotton cannot be classified as a "non-food" plant. Cotton seeds are the fourth most common macro-vegetal element in feces from Antelope House (see Chapter 14).

Spatial Variation in Textiles

Ethnographic data suggest that kiva utilization and kiva group recruitment rules have a spatial aspect. Hopi kivas historically have been loosely associated with different clans (Parsons 1939: 10).

The structural layout of the PIII Antelope House pueblo (i.e., North and South Room blocks, separated by a central area of distinctive architectural characteristics) led us to hypothesize the presence of separate social units in the

North and South Room Blocks (see Chapter 7). The ethnographic data linking kivas and particular spatial units suggested that the kivas at Antelope House may have been associated with their respective room blocks. There were two kivas (18 and 47) in the North Room Block during Late PIII, two in the South Room Block (A and 23), and one in the Central Room Block (42). The dating of the kivas to the Late PIII period is not fine enough to determine whether the two kivas in each of the first two room blocks were contemporaneous or sequential. Stratigraphy indicates that Kiva 47 was constructed prior to Kiva 18. The situation is not so clear in the South Room Block, but architectural analysis suggests that Kiva A may predate the remodeling of Room 23 into a kiva.

In Late PIII times, then, each room block had at least one, and possibly two, kivas in use at any one time. It is interesting to note that in each room block the two Late PIII kivas are adjacent. This establishes the structural basis for hypothesizing that kiva recruitment did not cross-cut room blocks. Assuming a society in which men are weavers and in which weaving is done in kivas, if kiva membership is clan-based and clans are localized in the room blocks, then distribution of textile stylistic traits may be expected to reflect the North/South Room Block dichotomy.

Unfortunately, the distribution of textile stylistic traits also is dependent upon marriage and residence rules (cf. Hill 1970). In a patrilocal society, stylistic features of male-produced items would be expected to cluster spatially in a situation of patri-clan kiva membership. However, given any other residence rule, especially the often hypothesized matrilocal residence, stylistic features would be expected to distribute randomly unless the room blocks were endogamous. Endogamy is a necessary constraint because of probable gift-giving patterns. Few ethnographic data are available on textile gift-giving, but it is logical to assume that a weaver customarily provided textiles for both consanguineal and affinal relatives—specifically, wife, children, mother and sister—who would not be residing in the same room block. As a result,

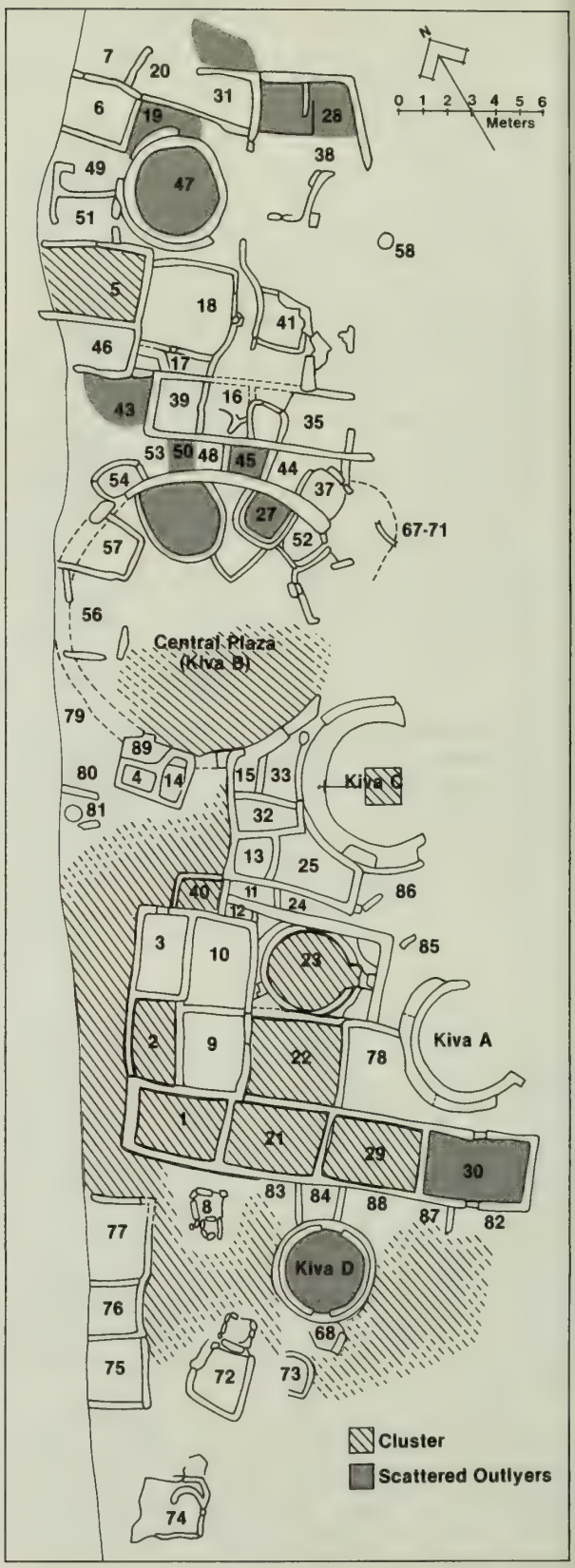


Figure 79. Clustering of plain weave textile traits at Antelope House.

Table 105. Plain weave thread counts, by room block.

	South Room Block	*Central Room Block*	*North Room Block*
Warp Predominant	367	72	69
	65%	46%	61%
Square	123	50	25
	22%	32%	22%
Weft Predominant	73	32	20
	13%	21%	18%

textiles made by one male weaver would be found in both room blocks. The hypothesis, therefore, must be formulated in the following manner: assuming male weavers associated with kivas and room block endogamy and/or patrilocal residence, if clans are localized in the room blocks, then stylistic features of textiles should be differentially distributed between the North and South Room Blocks.

The chi-square statistic was used to determine the significance of differences among textiles from the three room blocks in order to test for the expected differences between the North and South Room Blocks. The only significant difference revealed by chi-square is in plain weave thread count (Table 100: d). The Central Room Block has more square and less warp predominant, whereas the South Room Block has less weft predominant than expected (Table 105).

A non-metric multi-dimensional scale program (small space analysis of partitions) also was employed to study possible spatial clusterings of plain weave textile traits. The analysis considered 26 proveniences, all with more than four plain weave textiles, and 27 variables (thread count, thread color, selvage type, mending stitch, patching stitch and embroidery stitch). The multidimensional scale program allowed a simultaneous consideration of all 27 variables (in presence/absence form) in clustering the 26 proveniences on the basis of overall similarity of traits.

It was hypothesized that if the North and South Room Blocks were separate social units, the proveniences from the two room blocks should fall into separate clusters. The results do not support this hypothesis very well, indicating instead a loose clustering of rooms from the South Room Block and the southern portion of the Central Room Block (Fig. 79). Rooms from the North Room Block and the northern portion of the Central Room Block appear as scattered outlyers and form no clusters.

The cluster of south and south central rooms excludes only two South Room Block proveniences (Kiva D and Room 30) and includes the North Room Block provenience with the largest and most diverse sample (Room 5). This suggests that the "cluster" is merely a reflection of the large size of the constituent proveniences. However, not all large North Room Block proveniences are included (i.e., Rooms 42, 47 and North Trash) and several South Room Block proveniences within the cluster have small samples (Rooms 22 and 36). The cluster, therefore, cannot be a simple association of large samples.

The results of the study of textile stylistic traits indicate that the Central Room Block is not a homogeneous entity, but rather that the southern portion is actually part of the South Room Block and that the northern portion is associated with the North Room Block. The distribution of textile traits among the room blocks provides only very weak support for the hypothesized social differences between the North and South Room Blocks. It is not possible to accept the hypothesis that kiva recruitment was restricted to room block residents. However, neither is it possible to distinguish, at least on the basis of the textile study, whether it is the hypothesized recruitment rule or the assumption of endogamy-patrilocality which is being violated. Perhaps it is both.

Textile Regional Comparisons

The Antelope House textile collection is not really comparable to any other collection from a single Anasazi site. The collection upon which Kent based her 1957 study of Southwestern cotton weaving included textiles from more than 50 sites, yet the total number of specimens was less than 800. The small samples produced by other single sites (with the exception of the Salado site of Tonto) and the incompleteness in reporting textile traits make it difficult to conduct rigorous

Table 106. Comparative thread counts, by region.

	Antelope House	*de Chelly*	*Tsegi*	*Mesa Verde*
Plain Weave				
Warp Predominant	59%	67%	modal	42%
Square	25%	33%		18%
Weft Predominant	16%	0	39%	
Warps per cm	6–18	10–12	6–14	8–13
Wefts per cm	6–18	9–10	6–13	7–14
Twill Weave				
Warp Predominant	10%	25%	0	0
Square	10%	0	33%	17%
Weft Predominant	80%	75%	67%	83%
Warps per cm	6–15	5–9	6–21	9–14
Wefts per cm	7–17	8–24	?-21	10–18
Tapestry Weave				
Warps per cm	6–12	8	3	9
Wefts per cm	5–15	9	10–15	12

Table 107. Comparative twill weaving rhythms, by region (percentages).

	Antelope House	*de Chelly*	*Tsegi*	*Mesa Verde*
Over-2 Under-1	61	80	17	63
Over-1 Under-2	0	10	0	0
Over-2 Under-2	29	10	50	38
Over-3 Under-1	0	0	17	0
Over-4 Under-4	5	0	0	0
Over-2 Under-4	5	0	17	0

statistical comparisons on the basis of the published data. An attempt is made, however, to do a general comparison of Antelope House loom-woven textiles with specimens from the Canyon de Chelly region, as reported by Kent (1957) from the Tsegi Area, as reported by Anderson (1969) and Kent (1957, 1973); and from the Mesa Verde region, as reported by Brown (1975), Kent (1957) and Rohn (1971). The Canyon de Chelly collection includes 86 specimens, the Tsegi collection 325 specimens and the Mesa Verde collection 49 specimens.

Plain weave dominates all four collections, forming 88 percent of the Antelope House collection, 97 percent of the Tesgi textiles, 85 percent of the de Chelly textiles and 80 percent of the Mesa Verde textiles. The textiles of all four collections show little decoration. Only twined embroidery, brown and red dying and weft-wrap openwork are reported from the comparative collections, all of which are found on Antelope House plain weave textiles. The weft-wrap openwork links Antelope House with the Kayenta region, since the use of the technique on Anasazi textiles is restricted to that region (Kent 1957: 642). The thread counts from the four collections are summarized in Table 106. Thread counts from the comparative regions fall within the range of variation of the Antelope House textiles. The proportion of warps and weft predominance show that the Mesa Verde collection diverges most from Antelope House in the high percentage of weft predominance.

Twill constitutes 3 percent of the Antelope House textiles, 2 percent of the Tsegi and 12 percent of the de Chelly and Mesa Verde textiles. The somewhat larger proportions of twill in the Mesa Verde and de Chelly collections may be explained by the small samples from these areas and by the lack of screening for small fragments in the recovery of textiles from these regions. The thread counts from Tsegi fall outside the range for Antelope House, and the weft count for de Chelly exceeds the range from Antelope House in the predominance of wefts over warps.

The range of variation of weaving rhythm

in twill at Antelope House is greater than is seen in the other three collections, as shown in Table 107. The only weaving rhythms from the three comparative areas not found at Antelope House are the 1/2 rhythm found at another site in de Chelly (White House) and the 3/1 from Tsegi. The most common rhythms in all four collections are 2/2 and 2/1.

The decorative colors and motifs of the twill from all four areas belong to Kent's Anasazi Stripe category. Overall, there is greater variation among twills than among plain weaves, but the textiles from the three comparative samples fall within the range of variation of Antelope House twills.

Tapestry is a minor part of all collections, constituting 0.3 percent of the textiles at Antelope House, 5 percent in de Chelly and 2 percent in Tsegi and Mesa Verde. With the exception of the warp count at Tsegi, the three comparative collections do not exceed the range of variation at Antelope House.

The textiles from the three comparative collections, then, fall within the range of variation of Antelope House textiles in all but a few characteristics. The greatest divergences are present in the smallest samples, suggesting sampling error as an explanation. Kent (1957: 642) suggests a number of probable localized developments which differentiate the Tsegi and Mesa Verde regions. She considers weft-wrap openwork and reinforced selvages to be particularly characteristic of the Kayenta Branch (Tsegi), while Anasazi twill stripes, twill tapestry and diamond twill are Mesa Verde traits. Antelope House is linked to Tsegi and Mesa Verde by the presence of all of the above characteristics. Even on the basis of her smaller sample, Kent recognized that Canyon de Chelly contains the greatest variety of all Anasazi collections. Possible explanantions for the diversity of de Chelly textiles and for the relationship of de Chelly with Mesa Verde and Tsegi in textile manufacture and trade are considered below in the subsection on the cotton behavioral chain model.

Summary of Textile Variation

Antelope House textiles encompass 15 weaving techniques, eight weaving rhythms, 15 main selvage types, 14 basic design technique-motif combinations and eight stitch types, as well as many variations in thread material, color, ply, spin, twist, diameter and count. These diverse elements do not associate in a random manner, but are patterned by a number of factors.

Weaving technique is determined by the purpose to which the finished product was to be put. Thus, socks are looped, but a basket is more likely to be plain weave. The choice among yucca, hair and cotton for yarns is governed by weaving technique. Material preferences for sewing yarns change over time from yucca to cotton, as well as in accordance with their function in mending, patching, selvage or embroidery. Thread spin varies with material, but ply depends upon function. Stitch types are determined largely by the functional requirements of patching or mending, although individual preferences for certain stitches also seem to have played a role.

Weaving rhythm is bound up with weaving technique, since it is one of the major criteria upon which the weaving technique classification is based. Thread counts also vary with weaving technique and, in the case of plain weave, with period and room block.

Selvage techniques vary for warp and weft edges and, secondarily, according to weaving technique. Although the most common selvage types (twined and overcast) randomly associate with the loom weaves, selvage types are less variable on non-loom weaves. Thus, flat braided specimens have square braided fringe, while looped and weft-twined textiles have self selvages.

Certain design techniques and elements are more commonly associated with certain weaving techniques. For instance, embroidery is characteristic of plain weave, while colored weft bands and stripes are more likely to be found on twill and chevrons on tapestry weaves.

Such correlations indicate a strong degree of patterning in textile manufacture, despite the variety of techniques and elements available to the weaver. The ultimate determining factor can probably be said to be function. Once the weaver has decided to make a blanket rather than a cradle band, he has started the decision-making process which step-by-step eliminates certain elements of variability from consideration. The most common correlation of the various textile traits is with weaving technique. This suggests that the categories of weaving technique which have been identified for analytical purposes also have validity as behavioral categories.

Textile Manufacturing Artifacts

Almost the complete tool kit used historically by the Hopi for textile manufacture exists at Antelope House. These artifacts fall into four functional classes—ginning, spinning, weaving and sewing (see Fig. 80, 81).

Ginning is represented only by a possible beater, a tool used for whipping raw cotton to remove seeds and to fluff the fibers. The beater consists of a four-branched *Rhus trilobata* twig bound medially with one of its branches. It measures 33.6 cm in length and 8.5 cm in maximum diameter.

Spinning of fibers into yarn is represented by spindle shafts and whorls. There are four spindles with the whorl in place on the shaft, two separate shafts and 20 whorls. The shafts are use-polished, with bluntly rounded ends and, in one case, a bifacially beveled tip. Three are complete and range in length from 39.6 cm to 45.0 cm, with a mean of 43.2 cm. The diameter is uniformly between 0.5 and 0.6 cm. The shafts are made of *Sarcobatus vermiculatus* (3), *Chenopodium berlandieri* (1), *Lagenacia* (1) and an unidentified non-coniferous species (1).

The whorls can be classified into three types, according to shape. Thirteen are disks and 11 are cylinders; the four dating prior to Late PIII are disks. There is also a crudely made napiform clay spindle whorl, 2.0 cm thick and 2.5 cm in diameter. The disks range in thickness from 0.3 cm to 0.9 (mean = 0.5 cm). The diameters vary from 4.2 cm to 7.8 cm (mean = 5.8 cm). The cylinders are 2.0 cm to 3.4 cm thick (mean = 2.8 cm) and 2.7 cm to 4.1 cm in diameter (mean = 3.3 cm). The disk whorls are made of *Populus* sp. (3), *Cucurbita* sp. (3), *Acer negundo* (2), *Juniperus* sp. (2),

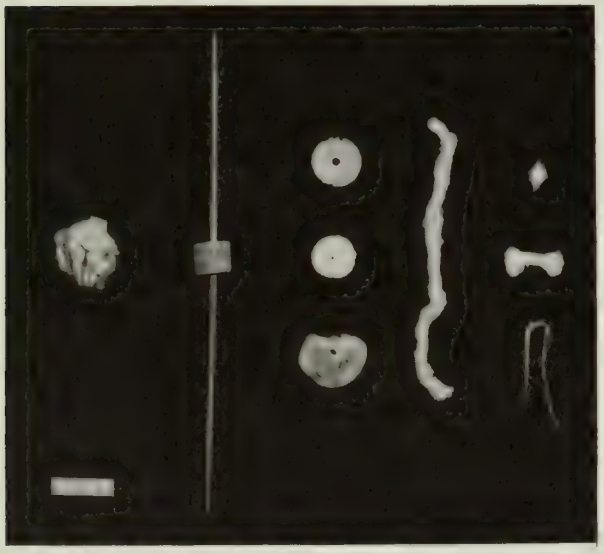


Figure 80. Spinning tools from Antelope House: (from left) raw cotton, **Sarcobatus vermiculatus** *spindle shaft with Salicaceae spindle whorl, three spindle whorls (horn at top, curcurbit and* **Acer negundo***), cotton yarn and (from top) cotton yarn on twig, cotton yarn bundle and* **Yucca angustissima** *tip needle with cotton thread.*



Figure 81. Weaving tools from Antelope House: loom anchors (top left) of **Salix** *sp. and of* **Salix** *sp. and* **Zea mays***; battens (lower left) of* **Populus** *sp. and of* **Juniperus** *sp.; finishing needles (center) of* **Sarcobatus I vermiculatus** *wit sinew binding and hair cord and of* **Philadelphus microphyllis** *with sinew binding; shed sticks (top right) of* **Sarcobatus vermiculatus,** *and weaving combs (lower right) of* **Populus** *sp.*

Quercus gambelii (1), Salicaceae (1) and one is keratogenous (horn). The cylinders are made of Salicaceae (5), *Acer negundo* (2), *Populus wisilizenii* (1), *Cucurbita pepo* peduncle (1), *Yucca angustissima* caudex (1), and *Yucca* sp. caudex (1).

Weaving is evidenced by loom anchors, heddles, shed rods, shed sticks, battens, weaving combs and finishing needles. Heddles are used to control the weaving rhythm of the wefts by shifting the position of certain warps to which the heddles are looped. Two fragmentary heddles from Antelope House measure 35.2 cm (L) × 3.0 cm (W) × 1.8 cm (Th) and 38.6 cm × 2.4 cm × 0.7 cm. One is rectangular and the other is triangular in cross section. Both exhibit use-stain and polish on faces and ends. One is of *Juniperus scopulorum* and the other of *Juniperus* sp.

Shed rods are used for controlling weaving rhythm by inserting them into the shed of warps in different ways. There are eight fragmentary shed rods, varying in length from 6.0 cm to 19.7 cm (incomplete) and in diameter from 0.5 cm to 2.0 cm (mean = 1.2 cm). Shed rods generally are plano-convex, although some specimens tend to be more rounded and others more rectangular. Ends are tapered and rounded. Faces show use-polish and sometimes diagonal or transverse striations. Shed rods are made of Salicaceae (2), *Salix* sp. (1), *Acer negundo* (1), *Populus* sp. (1), *Fendlera rupicola* (1), *Juniperus* sp. (1), and *Sarcobatus vermiculatus* (1).

Shed sticks are used in much the same way as are shed rods, but they are more slender and are often crooked, with a flat bevel on the tapered tip. Only two of the 52 shed sticks from Antelope House are complete. These measure 51.5 cm and 54.0 cm long. The diameter of all shed sticks ranges from 0.4 cm to 1.0 cm (mean = 0.6 cm). Most exhibit use-polishing on the shaft. Shed sticks are made of *Sarcobatus vermiculatus* (49), *Acer negundo* (1), *Quercus turbinella* (1) and *Quercus* sp. (1).

Battens are used to tighten the weave by tamping the wefts down during the weaving process. They also can be used as shed rods. There are 17 battens, five of them complete. The complete specimens range in length from 19.5 cm to 40.0 cm (mean = 31.2 cm). The complete battens would be more useful on a narrow loom, due to their short length. However, two of the broken battens are longer (51.5 cm and 60.8 cm), indicating the presence of larger battens for use on the wider vertical loom. Battens range in width from 1.7 cm to 4.4 cm (mean = 3.1 cm) and in thickness from 0.5 cm to 1.9 cm (mean = 1.1 cm). Ends are tapered and rounded, some tending toward diagonal. Cross sections usually are plano-convex, although some tend toward oval or sub-rectangular. One face usually is smoothed, use-polished and occasionally striated, while the opposite face is more irregular, although smoothed. One specimen is impregnated with pitch. Materials used in battens are *Juniperus* sp. (4), *Juniperus scopulorum* (1), Salicaceae (4), *Populus* sp. (3), *Acer negundo* (2), *Cercocarpus* sp. (1), unidentified coniferous species (1), and unidentified (1).

Loom anchors are buried beneath the floor to anchor the lower bar of the vertical loom. Ten loom anchors were recovered from Antelope House. The placement of the *in situ* anchors (see Chapter 5) indicates that four normally were used for a single loom. The loom anchors measure 11.5 cm to 24.3 cm (mean = 17.1 cm) long, 4.0 cm to 12.0 cm (mean = 6.5 cm) wide, and 0.8 cm to 10.0 cm (mean = 4.9 cm) thick. Component materials and construction techniques are diverse. The most common type, represented by four anchors, is made of looped and wrapped *Salix* sp. twigs. Two are constructed of a looped *Quercus gambelii* twig and four to five *Zea mays* cobs wrapped with *Yucca angustissima* ties. Two others are of *Salix* sp. twigs wrapped with *Yucca baccata* ties. One is of looped and wrapped *Rhus trilobata* and another is of looped and wrapped *Yucca baccata* leaves. Six of the 10 have one loop extending above the body of the artifact to form the actual anchoring device. The positions of the parts of the loom are diagrammed in Fig. 82.

Weaving combs are used to tamp down wefts to tighten the weave. Two *Populus* sp. weaving combs were recovered. They are rectangular tablets, with flat or slightly tapering and curved bases. The opposite end has short tines (less than 1 cm in length); one comb has seven tines and the other 10. Both show use-stains and polish around the tines. The combs are 8.1 cm to 11.8 cm long, 3.4 cm to 4.1 cm wide and 0.6 cm to 1.4 cm thick.

Finishing needles are used to draw the final weft yarns through the warps as the weaving nears completion. Fourteen of the 51 finishing needles are complete, ranging in length from

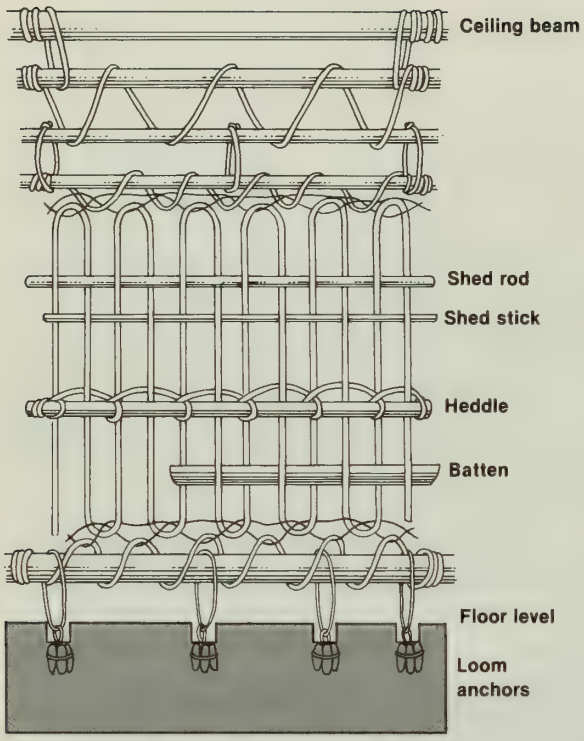


Figure 82. Diagram of the vertical loom.

Table 108. Spinning and weaving tools over time.

	P I	*P II*	*EP III*	*MP III*	*LP III*
Battens	1		2	4	6
Beaters				1	
Finishing needles		1	1	9	32
Heddles					2
Loom anchors		2			7
Shed rods	1	1	1		4
Shed sticks		1	4	10	35
Spindle shafts				1	4
Spindle whorls		2		2	17
Weaving combs					2
TOTALS	2	7	8	27	109
	1.3%	4.6%	5.2%	17.6%	71.2%

23.7 cm to 38.8 cm (mean = 31.1 cm). The diameter of all finishing needles is uniformly between 0.3 cm and 0.6 cm (mean = 0.4 cm). Finishing needles are slender rods with one flat end and one pointed end, the latter usually showing use-polish. Between 3.6 cm and 12.8 cm (mean = 8.4 cm) from the flat end, there is a sinew or hair binding. Fourteen have sinew bindings securing a hair cord, 14 have only the sinew binding and three have a plain 2-ply hair cord tied to the rod. The other 20 finishing needles lack the binding, but exhibit wear patterns indicating its former presence. Materials used for the rods are *Sarcobatus vermiculatus* (25), *Acer negundo* (8), *Philadelphus microphyllus* (4), *Salix* sp. (4), Salicaceae (2), *Fendlera rupicola* (2), *Senecio* (2), *Quercus turbinella* (1), *Rhus trilobata* (1), *Atriplex* sp. (1), and unidentified non-coniferous species (1).

Sewing is evidenced by 58 *Yucca angustissima* needles. The needles are made of the top of the yucca leaf, which is stiff and pointed. The leaf is partially shredded at a point 2.0 cm to 9.0 cm (mean = 5.2 cm) from the tip. This shredded fiber is twined; in four cases it is intertwined with cotton yarn and in three cases, with unidentified bark yarn. Two polished *Acer negundo* needles, with eyes, have been found, one with *Yucca* sp. fiber thread in place. These needles are 7.2 cm long and 0.5 cm wide at the base. They were discovered stuck into a bundle of six human hair cord bundles (see Fig. 75).

Eight cotton yarn bundles were recovered. One is a skein of Z-spun cotton 31 cm long. Another is a bundle of Z-spun cotton bound medially into a figure-8 form and is 5 cm long. There also are one 3-ply and two 2-ply cotton yarn bundles in figure-8 form, 3.4 cm and 5.8 cm in length. Three bundles have cotton yarn wrapped about some other material. A length of 2-ply cotton is wrapped on a 2-ply S-spun Z-twist *Yucca* sp. fiber cord, forming a bundle 5.5 cm long. Some single-ply cotton is wrapped on a 6.7 cm long *Rhus trilobata* twig and another length of single-ply cotton yarn is wrapped on a split *Quercus gambelii* twig 2.7 cm long.

The ginning, spinning and weaving tools date from PI to Late PIII (Table 108).The number and variety of artifacts increase steadily over time. The majority (71 percent) of the tools are from Late PIII, although virtually the whole range of textile-related tools are present by PII, even if in small quantities.

Sandals

The sandal collection from Antelope House consists of 406 complete and fragmentary specimens. Almost 50 percent were recovered from

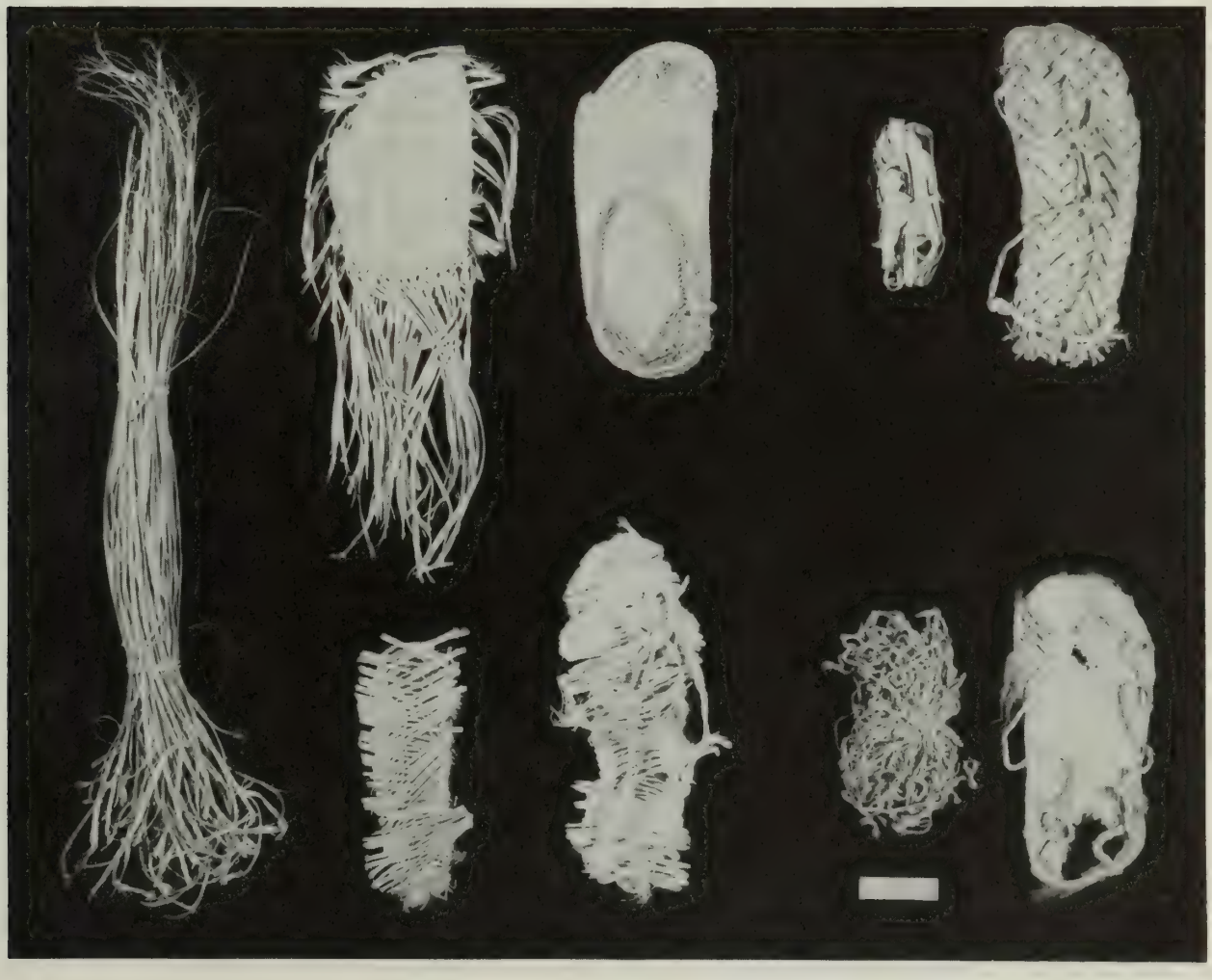
the South Room Block, due to the extensive accumulation of dry trash deposits in that part of the site. The sandals are divided into three main types, according to weaving technique: plaited, twined and wicker. Two subtypes of plaited—coarse and fine—were distinguished, as were three subtypes of twined—plain, diagonal and composite plain/diagonal (see Fig. 83).

Through the use of frequency tables, cross-tabulations and the chi-square statistic, the features characteristic of Antelope House sandals were isolated and compared. Such analyses facilitated sandal description for typological purposes, as well as providing some insight into the behavior patterns associated with sandal manufacture and use.

Sandal characteristics also were studied in spatial and temporal terms. Specifically, sandals from the South and North Room Blocks were compared in connection with the hypothesized social difference between the room blocks. Previous sandal studies indicate that twined sandals were more popular in early periods (Basketmaker), while plaited sandals were more characteristic of Pueblo periods. Anderson (1969: 129) suggested that coarse-plaited sandals were slightly earlier in the Tsegi area than fine-plaited. Temporal differences such as these were sought in the Antelope House data.

The collection consists of 49 percent complete sandals, 15 percent heels, 10 percent toes, 11 percent toe and midsections, 4 percent mid-

Figure 83. Sandal weave types and raw materials: (clockwise from left) **Yucca angustissima** *bundle, unfinished fine plaited sandal,* **Yucca baccata** *bundle, coarse plaited sandal, twined (plain) sandal,* **Yucca** *sp. cordage bundle, complete wicker sandal and unfinished wicker sandal.*



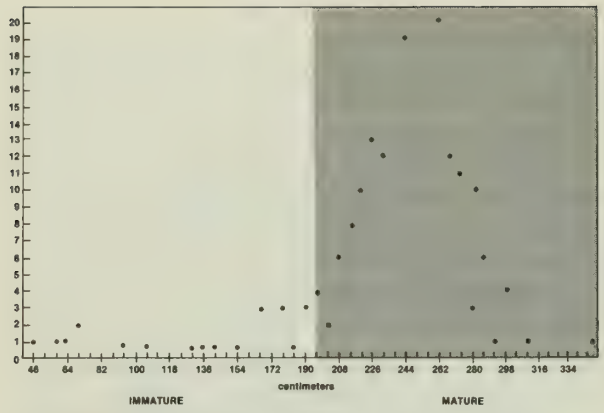


Figure 84. Distribution of sandal sizes at Antelope House.

sections, 1 percent fragments parallel to the long axis, and 10 percent indeterminate fragments. Sandals which appear to be unused constitute 54 percent of the finished sandals. Signs of moderate wear on the sole are found in 40 percent of the specimens, while 54 percent have holes in the heels and/or toes. Approximately half of the sandals may be identified as to which foot they fit, with 29 percent fitting the left and 25 percent fitting the right. Sandal lengths range from 5.8 cm to 35.0 cm for complete specimens. The sandals under 19.5 cm are considered toys, ceremonial items or for immature individuals. These "miniature" sandals make up 11 percent of the collection. Sandal sizes are graphed in Figure 84 (see also Fig. 85).

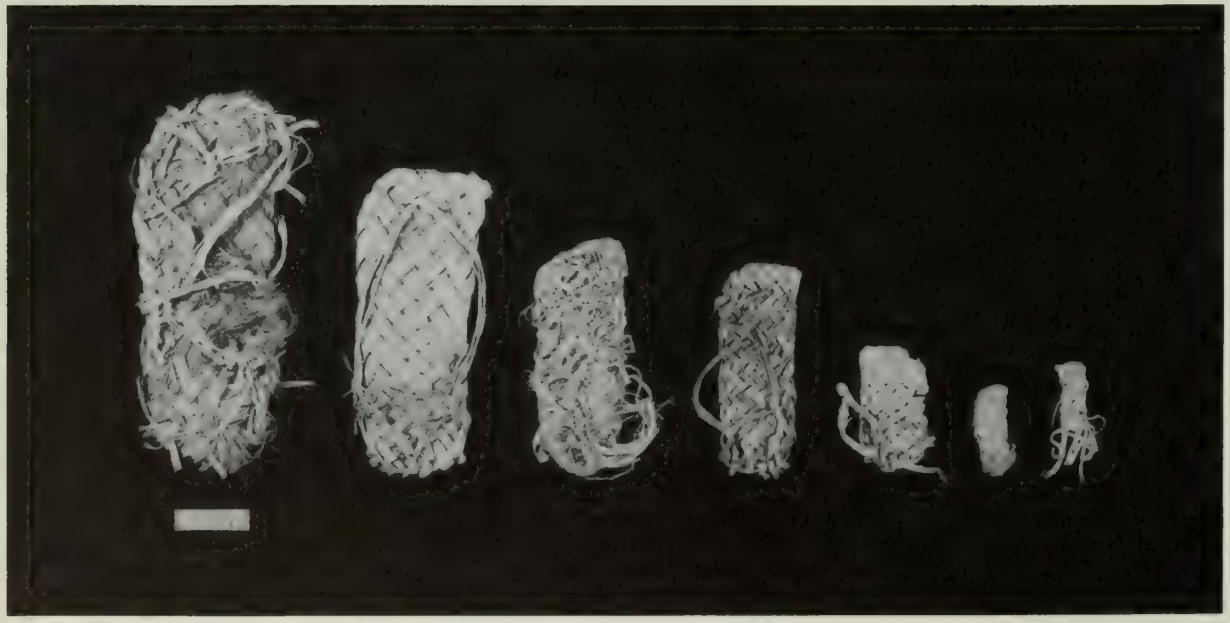
Sandal pads were found on eight specimens and eight pads were recovered unassociated with their sandals. Sandal pads usually are found with coarse-plaited sandals, but two fine-plaited and one twined sandal have pads. Fifty percent of sandal pads are *Zea mays* husks, 25 percent are shredded *Juniperus* bark and there is one instance each of coarse *Yucca* sp. fiber, *Sporabolus cryptandrus, Graminiae* sp. and cotton textile pads (see Fig. 67).

Coarse-Plaited Sandals

Coarse-plaited sandals from Antelope House conform generally to Kidder and Guernsey's (1919: 101) Type Ial, in which seven or eight folded yucca leaves pass alternately over and under each other. Such sandals constitute 36 percent of the sandal collection (148 specimens). The plaited elements are 95 percent *Yucca baccata* leaves, partially split. The other 5 percent of the elements are *Yucca angustissima* leaves, which are found only in the "miniature" sandals. The width of the yucca elements ranges form 0.4 cm to 3.0 cm (mean = 1.2 cm).

The collection of coarse-plaited sandals consists of 85 (57 percent) complete specimens, as well as of three unfinished sandals, four unworn sandals lacking straps and two sandals with

Figure 85. Range of sandal sizes recovered. All but third from left are coarse-plaited: (from left) large adult size, average adult, three immature and two miniature.



straps but with no discernible wear. The bulk of the collection, however, is worn; 62 percent are moderately worn on the sole and 31 percent are worn out, with holes in the heel and/or toe. Kidder and Guernsey note that coarse-plaited sandals are limited to a length of 8 inches (20.2 cm), due to their construction from unspliced elements. In this respect, Antelope House coarse-plaited sandals differ from those studied by Kidder and Guernsey, since they range in length from 4.5 cm to 31.0 cm (mean = 24.4 cm). These sizes are comparable to coarse-plaited sandals from the Tsegi area, which range up to 26 cm in length (Anderson 1969: 129). In contrast both to Kidder and Guernsery and to Anderson, who found that all coarse-plaited sandals were 2/2 in weaving rhythm, the sandals from Antelope House are 54 percent 1/1, 22 percent 2/2, 15 percent 2/1 and 8 percent irregular. Thus rhythm in coarse-plaited sandals is more varied than previously reported and the 1/1 rhythm is more common than 2/2.

Kidder and Guernsey report coarse-plaited sandals to be characterized by square and, secondarily, by round toes, with contoured toes being rare. The sandals from Antelope House again are different; only 20 percent have square toes, 13 percent have round toes, 41 percent have a contoured toe shaped to fit the foot, and 23 percent are angular (basically contoured to fit the foot). Diversity is not limited to the four main toe shapes; there also is one specimen each with concave toe, flared toe, pointed toe, and contoured with a jogged-toe.

Heel shape is less variable, with 54 percent of the sandals having round heels, 42 percent square heels, and 4 percent pointed heels. The most characteristic heel selvage (72 percent) is formed by turning alternate elements about a knotted transverse element. Odd elements are cut off underneath, while the others are folded back over the tope of the sandal to form a heel pad on the upper surface of the sandal, as described by Kidder and Guernsey. There are two variations on the heel pad at Antelope House. On one sandal, the heel pad is formed on the under surface of the heel; the elements are turned under, rather than over, to form the pad. The other variation consists of a heel pad on the upper surface, in which each element of the pad has been slipped under an adjacent element. A selvage formed by simply knotting two edge elements is found in 18 percent of the specimens. Elements are turned back into the weave in a type of self selvage in 8 percent of the cases. Heel selvage types are illustrated in Figure 86.

Straps are 59 percent edge loops with "Z" lacing zigzagging across the instep and 49 percent toe-heel loops with lacing in the form of a "Y" connected to each of the loops. Edge loops are 57 percent overlapping and 30 percent non-overlapping. Toe and heel loops are doubled in 18 percent of the instances of that strap type. Strap types are illustrated in Figure 87. Straps are 86 percent partially shredded *Yucca angustissima* leaves and 14 percent coarse *Yucca* sp. fiber. The occurrences of ply, spin, twist, and width of straps are presented in Table 109.

Coarse-plaited sandals generally are undecorated. However, decorative running stitches of *Yucca angustissima*, which form an outlining pattern around the edges of the sandal, are found in four cases. This stitching may be decoration or reinforcement. Another sandal has braiding in two concentric "U" designs on the under surface, and one sandal has scattered knots on the under surface. It is uncertain whether the braiding and knotting are decorative or designed to increase traction.

Fine-Plaited Sandals

Fine-plaited sandals are representative of Kidder and Guernsey's (1919: 101–102) Type Ia2, in which 20 to 30 leaves are diagonally plaited. Fine-plaited sandals make up 42 percent of the collection (172 specimens). The plaiting elements are whole *Yucca angustissima* leaves, which range in width from 0.2 cm to 0.8 cm (mean = 0.4 cm). Exceptions include two sandals with elements of 2-ply Z-spun S-twist fine *Yucca* sp. fiber and one sandal made of *Scirpus* sp. Weaving rhythm is 91 percent 2/2 and 7 percent 1/1. One case of 2/1 and two cases of irregular rhythm were noted. This is basically in accord with the 2/2 rhythm reported by Kidder and Guernsey (1919: 101–102) and by Anderson (1969: 130).

There are 80 (47 percent) complete fine-plaited sandals and 14 (9 percent) unfinished. The majority of the sandals are used (49 percent) or very worn (34 percent), but 8 percent appear to be unworn. Fine-plaited sandals range in length from 6.0 cm to 35.0 cm (mean = 22.4 cm). Thus they tend to be smaller than coarse-plaited sandals. The "miniature" sandals are predomi-

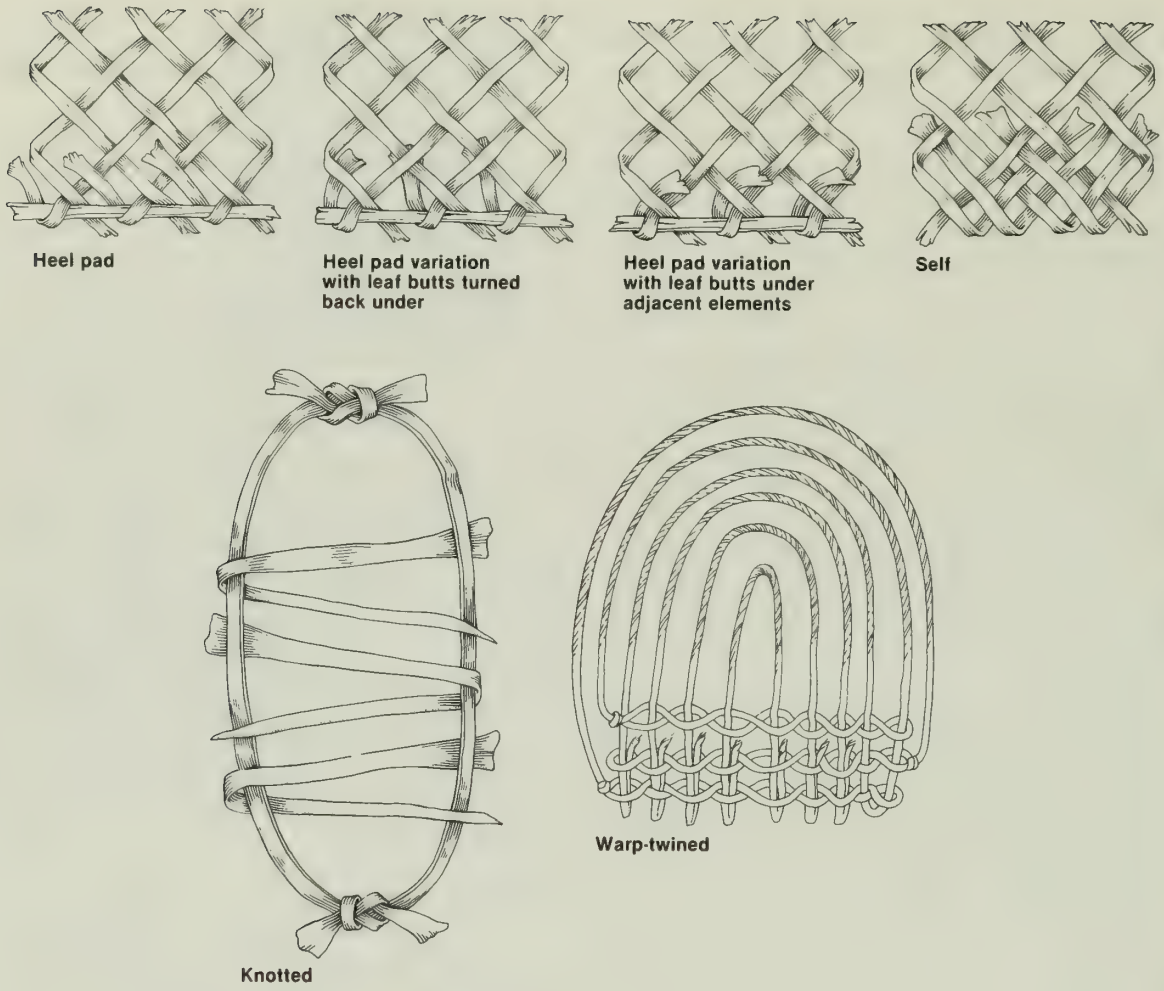


Figure 86. Sandal heel selvage types from Antelope House.

nantly fine-plaited (70 percent).

Toe shapes are varied: 33 percent are contoured, 23 percent are contoured with a jogged toe, 17 percent are angular contoured, 12 percent are square, 11 percent are round, and 4 percent are flared. Heel shapes are confined to square (60 percent) and round (40 percent). Heel selvages are heel pads in 45 percent of the cases, self in 34 percent, turned under heel pads in 6 percent, heel pads with leaf butts slipped under adjacent elements in 6 percent, and knotted in 5 percent. One specimen has a false braid selvage formed by turning alternate leaves to the upper or under surface (Morris 1959: 397). Edge borders are created in a number of ways, most commonly (77 percent) by pulling the elements tightly to create the effect of a rolled border. Elements are angled and woven back into the body of the sandal to form a 2 cm-wide border in 13 percent of the cases. One specimen has two rows of rolled border, one has three rows of border, and one has a false braid border.

Straps are 56 percent toe-heel loops, 28 percent of which are doubled. Edge loops are found in 45 percent of the sandals and 71 percent of such loops are overlapping. One sandal was both edge loops and toe-heel loops. Another unique specimen has a V-shaped thong strap, which is secured between the first and second toes. Strap material is 62 percent partially shredded *Yucca angustissima*, 30 percent coarse *Yucca* sp. fiber, and 6 percent mixed *Yucca* sp. fiber and hide strips. Unique specimens include one with fine *Yucca* sp. fiber and *Zea mays* husk straps and

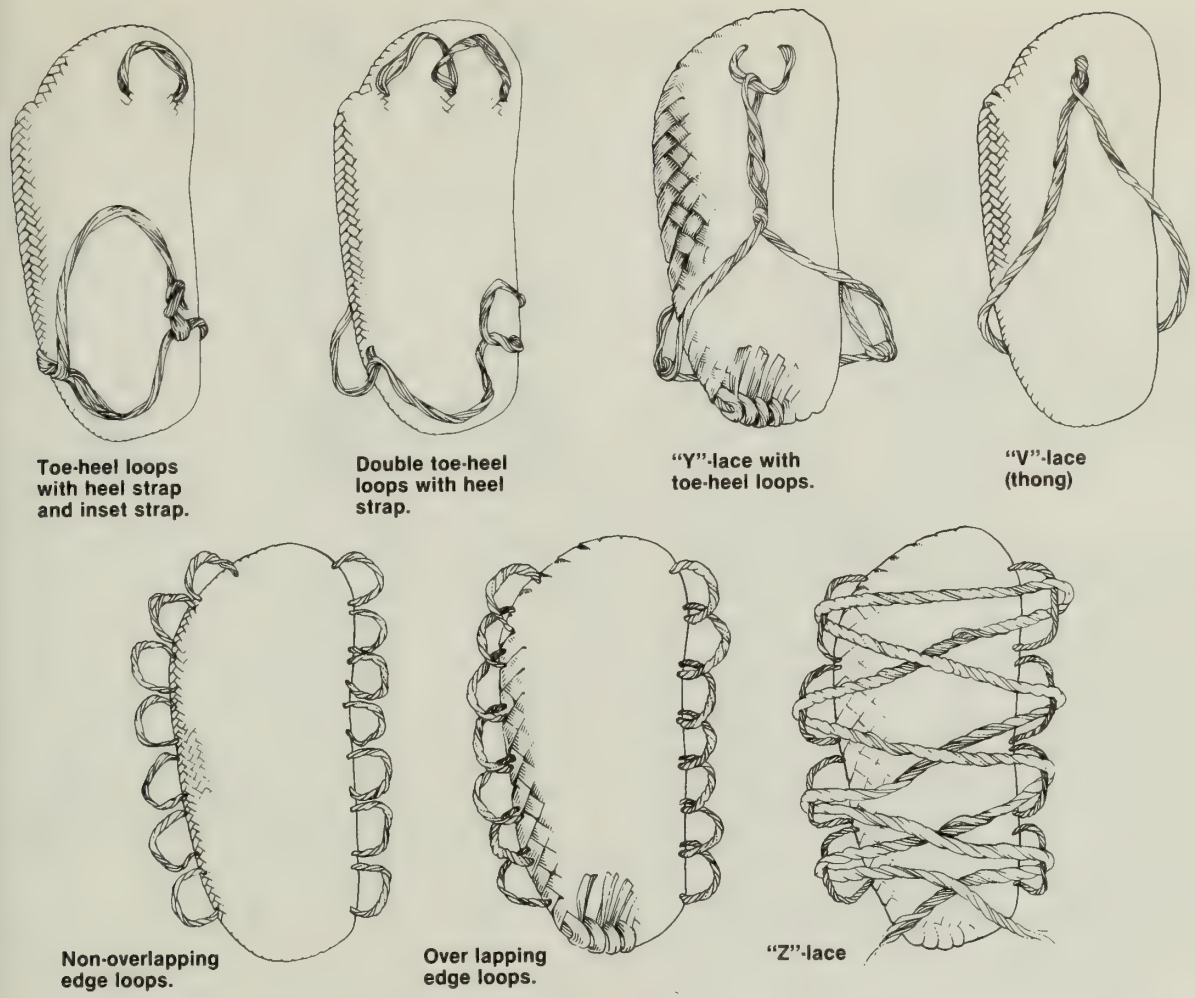


Figure 87. Sandal strap, lace and loop types from Antelope House.

another with *Yucca* sp. fiber and unidentified bark fiber. Lacing material is less variable, with 80 percent being *Yucca angustissima* leaves, 11 percent fine *Yucca* sp. fiber, 6 percent coarse *Yucca* sp. fiber and one case of both *Yucca* sp. fiber and split leaf. Characteristics of fiber used in straps and lacing are presented in Table 109.

Decoration of fine-plaited sandals is uncommon. There is a single instance of brown-dyed elements which form diamonds. Stitching, either for decoration or for reinforcement, includes zigzag running stitches of coarse *Yucca* sp. fiber on two specimens, running stitches of fine *Yucca* sp. fiber in an outlining pattern around the edges of one sandal, and twined stitches in an indeterminate motif of *Yucca angustissima* leaves on one specimen.

Twined Sandals

Twined sandals conform to Kidder and Guernsey's (1919: 103–104) type IIb, in which fiber cord wefts are twined about fiber cord warps. The sandal collection from Antelope House includes 19 percent twined sandals (78 specimens). There are two main styles of twining: plain twining, with 1/1 rhythm (an exception being a single specimen with 2/2 rhythm), and diagonal twining, which creates diagonal ribbing by varying the warps over which each weft passes. Six sandals are diagonal twined, four with 2/2 rhythm and one with 1/1 rhythm. There are two specimens in which plain and diagonal twining occur in alternating bands. Rhythm in these composite specimens changes from 1/1 in the plain twine to 2/2 in the diagonal twine.

Table 109. Fiber strap characteristics for sandals.

	Coarse plaited N/%	*Fine plaited* N/%	*Twined* N/%	*Wicker* N/%
Strap/lace material				
leaf strap	95/86	62/62	0	1/100
Hide strap	0	0	10/22	0
fiber strap	16/14	38/38	36/78	0
leaf lace	40/87	28/80	3/50	1/100
fiber lace	6/13	7/20	3/50	0
Strap ply-spin-twist				
1-S	8/57	5/14	1/13	
1-Z	3/21	4/11	1/3	
2-S-Z	3/21	17/46	17/47	
2-Z-S	0	7/19	7/19	
3-S-Z	0	0	4/11	
3-Z-S	0	0	3/8	
2-Z-S, 2 reply-Z	0	2/5	1/3	
2-Z-S, 3 reply-Z	0	0	1/3	
1-Z-3 strand braid	0	1/3	1/3	
6-?-?	0	1/3	0	
Lace ply-spin-twist				
1-S	2/50	0	0	
1-Z	1/25	0	0	
2-S-Z	1/25	2/33	1/33	
2-Z-S	0	4/67	1/33	
3-Z-S	0	0	1/33	
Strap width				
range (cm)	0.2–1.0	0.2–1.0	0.2–1.0	0.6
mean (cm)	0.6	0.5	0.5	

The number of warps varies from five to 13, with a mode of eight and a mean of seven. Warps are coarse *Yucca* sp. fiber, which is usually (97 percent) 2- or 3-ply S-spun S-twist. Two sandals have S-spun Z-twist warps and one sandal has Z-spun S-twist 3-reply Z-twist. Twists per cm vary from two to six. Wefts are fine *Yucca* sp. fiber, with the exception of a sandal with shredded *Juniperus* sp. bark wefts. Wefts are 2-ply Z-spun S-twist in 92 percent of the cases, with the balance being S-spun Z-twist. Twists per cm range from two to nine (mean = 7.1). Weft diameters range from 0.1 cm to 0.4 cm (mean = 0.1 cm).

Length of twined sandals varies from 15.8 cm to 29.0 cm (mean = 26.1 cm). Thus they tend to be larger than plaited sandals. Complete twined sandals account for 37 percent of the specimens. One sandal is unfinished, but the others are moderately worn (18 percent) or heavily worn (73 percent).

Toe shape is less variable than in plaited sandals. Toes are 37 percent contoured with jogged-toe, 34 percent contoured and 26 percent round. Heel shapes are 83 percent round and 17 percent square. Heel selvages are warp twined, a technique described by Kidder and Guernsey, in which the edge warps are turned back and twined about the central warps. The stretching of elements toward the center creates a cupped heel. Straps are 79 percent toe-heel loops and 21 percent edge loops. Twenty percent of the toe-heel loops are doubled and 57 percent of the edge loops are overlapping. Straps are 43 percent coarse *Yucca* sp. fiber, 30 percent fine *Yucca* sp. fiber, 22 percent hide strips, and 4 percent mixed *Yucca* sp. fiber and unidentified bark fiber. Fiber cord straps are much more common on twined sandals than on plaited. Lacing material, however, is similar, with 50 percent *Yucca angustissima*, 33 percent fine *Yucca* sp. fiber, and 17 percent coarse *Yucca* sp. fiber. Strap and lacing

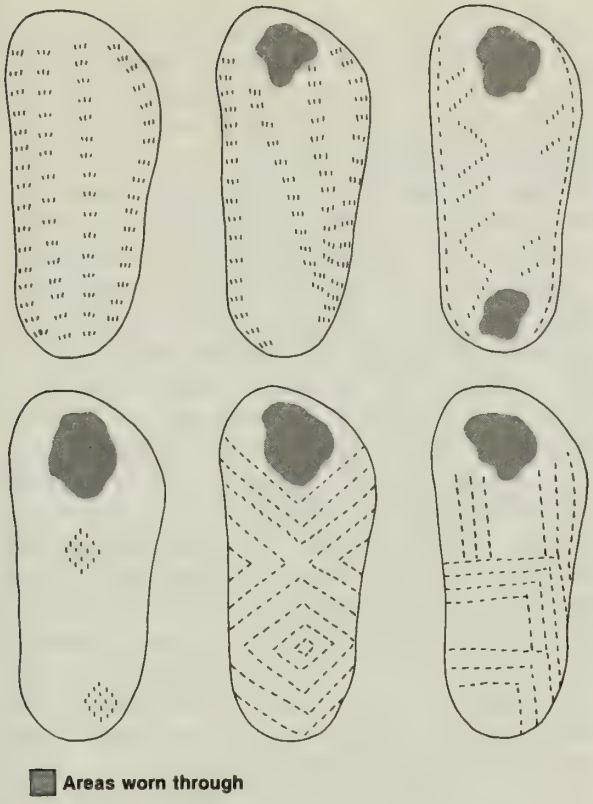


Figure 88. Raised knot motifs on sandal soles.

characteristics are summarized in Table 109.

Raised patterns of knots are found in 54 percent of the twined sandals. As described by Kidder and Guernsey (1919: 105), such knots are formed by taking a double turn of one twined element about its pair. Motifs include 32 percent columns of short stripes, 26 percent horizontal strips and/or bands, 16 percent keys and/or steps, 13 percent diamonds, 5 percent chevrons, and 3 percent outlining the edges. Motifs are illustrated in Figure 88. E.A. Morris (1959: 386) suggests that these knots form a traction tread and serve to thicken those parts of the sandals which receive the greatest wear. However, 58 percent of the sandals with knots from Antelope House have them over the entire sole, in 15 percent, they are confined to the heel, and in only 5 percent to the toe, while 24 percent have them on the edges and/or center, rather than on the more vulnerable heels and toes. Morris also suggests that these knots lent individuality to a person's footprint. The locations of knots and the variety of motifs suggest that knots on twined sandals are more a matter of style or for the purposes of traction than for protecting sandals from wear.

Decorations are more common on twined sandals than on plaited. They consist of dyed wefts, which form horizontal stripes or bands on nine sandals and keys on one sandal (see Fig. 89). Weft colors include red (3 cases), brown (3), yellow (1), black (1), red and brown (1) and brown, yellow and white (1). Stitched decoration or reinforcement, consisting of hide overcast stitching around the edge of the sandal, is found in two instances.

Wicker Sandals

Wicker sandals fall under Kidder and Guernsey's (1919: 103) type Ib. These are constructed of whole yucca leaves woven over and under two yucca leaf warps tied together at either end. Wicker sandals are a very minor type at Antelope House, accounting for only 2 percent of the collection (eight sandals). Three of the wicker sandals are complete, ranging in length from 20.0 cm to 27.5 cm (mean = 24.7 cm). There are no "miniature" wicker sandals. One sandal appears to be unworn, the others to be moderately worn.

Four sandals have *Yucca baccata* warps and three have *Yucca angustissima* warps. The warps

Figure 89. Sandal decoration motifs from Antelope House.



are missing from one sandal. Warps range in width from 0.6 cm to 1.0 cm (mean = 0.8 cm). One specimen has warps formed of 2-ply Z-spun S-twist 3-strand coarse *Yucca* sp. fiber braid. The number of warps usually is two, but two sandals have four warps. Wefts are whole *Yucca angustissima* leaves. In six specimens, the under wefts are shredded to form a pad on the sole, as described by Kidder and Guernsey. Wefts range in width from 0.4 cm to 0.5 cm (mean = 0.5 cm).

Toe and heel are not readily distinguishable, since both are generally round and the sandal is not shaped to the contour of the foot. However, one specimen appears to have a square heel and another specimen has a pointed heel. Toe and heel selvages are formed by knotting the warps. One sandal has a toe loop with a "Y" lace, which at one time either was attached to heel loops or tied behind the ankle. The strap is made of partially shredded *Yucca angustissima* leaf 0.6 cm in width.

Sandal Characteristics: Generalizations and Correlations

A number of sandal characteristics vary with weaving technique, suggesting that weaving technique put certain constraints on sandal manufacture. Material is highly correlated with weaving technique; *Yucca baccata* leaves are associated with coarse-plaited, *Yucca angustissima* leaves with fine-plaited and wicker, and *Yucca* sp. cordage with twined. Particular weaving rhythms characterize each of the weaving techniques. Over-1 under-1 predominates in coarse-plaited and twined, while 2/2 is most common in fine-plaited (Tables 110, 111). The weaver of a coarse-plaited sandal apparently had more latitude in choosing a rhythm, however, since 89 percent of rare irregular and 2/1 rhythms are found in these.

Variations in toe shape also are non-randomly distributed (Tables 110, 111). Coarse-plaited sandals generally possess contoured toes; fine-plaited more commonly have jogged or angular contoured toes; and twined sandals have jogged and contoured toes. Angular toes, whether square or angular contoured, are not found on twined sandals, with the single exception of a specimen with an angular contoured toe. Likewise, jogged toes, again with one exception, are not found on coarse-plaited sandals.

Weaving technique has a significant bearing on heel selvages and shapes (Tables 110, 111). All wicker sandals have knotted heel selvages. Heel pads dominate coarse-plaited sandals, whereas self selvages are most common on fine-plaited, with heel pads next in frequency. Twined sandal selvages are uniformly warp twined and wicker selvages are all knotted. Round heels predominate on coarse-plaited and twined, while square heels are more common on fine-plaited. The type of heel selvage significantly affects the shape of the heel (Table 110). Heel pads and their variations tend to produce square heels in 59 percent of the cases, whereas self and knotted selvages produce round heels in 75 percent.

According to a chi-square test, strap type variation among weaving techniques may be explained by chance, although certain trends may be noted. Toe-heel loops predominate on both twined and fine-plaited sandals, but edge loops are slightly more common on coarse-plaited. Non-overlapping edge loops generally are rarer than overlapping edge loops on all sandal types, but non-overlapping edge loops make their strongest showing on coarse-plaited.

Strap material varies significantly with weaving technique (Tables 110, 111).*Yucca angustissima* straps are most commonly found on coarse- and fine-plaited sandal straps, while fiber and hide predominate on twined sandals. Fiber straps are especially rare on coarse-plaited. Strap material and strap type also are correlated. Fiber is more common (50 percent) in toe-heel loops, whereas leaf predominates (57 percent) in edge loops. Hide shapes are confined to toe/heel loops.

Sandals with toe loops vary in the toes over which the loops pass, but this variation is random. Most loops pass over toes 2 and 3 (38 percent) or over toe 2 (13 percent). Double loops pass over toe 1 and toes 2 and 3 (45 percent), or toes 1 and 2, and toes 3 and 4 (15 percent). Rarer are single loops over toes 1, 2 and 3 (four cases), over toe 1 (two cases), over toe 3 (one case), double loops over toes 1 and 2 and toes 1, 2, 3 and 4 (one case), and a thong between toes 2 and 3 (four cases). Knots used in selvages and straps are 75 percent square, 15 percent overhand, 6 percent granny and 3 percent larkshead. There is one instance of a half-hitch and one of a slippery reef knot.

Toe and heel shapes may involve almost any of the possible combinations. Such combinations are quite diverse, but the most common are con-

Table 110. Results of chi-square tests on sandals.

Null Hypothesis	*Results*
1. Variation in weaving rhythm (1/1; 2/2; 2/1; irregular) by weaving technique (coarse-plaited, fine-plaited, twined) is due to chance.	P<.005
2. Variation in sandal toe shape (square, round, contoured, angular contoured, jogged-toe) by weaving technique is due to chance.	P<.005
3. Variation in sandal heel shape (round versus square) by weaving technique is due to chance.	P<.005
4. Variation in sandal heel selvage (self, heel pad, heel pad variation, knotted, warp twined) by weaving technique is due to chance.	P<.005
5. Variation in sandal strap material (hide, *Yucca angustissima*, coarse yucca fiber, fine yucca fiber) by weaving technique is due to chance.	P<.005
6. Variation in sandal strap material (fiber, leaf, hide) by weaving technique is due to chance.	P<.005
7. Variation in sandal weaving technique (coarse-plaited, fine-plaited, twined) by period (PII-LPIII) is due to chance.	P<.005
8. Variation in rhythm (1/1; 2/2; 2/1; irregular) in coarse-plaited sandals by period is due to chance.	P<.05
9. Variation in coarse-plaited sandal heel shape (round versus square) by period is due to chance.	P<.025
10. Variation in fine-plaited sandal toe shape (round, contoured, angular contoured, jogged-toe) by period is due to chance.	P<.014

Table 111. Variation in sandal characteristics by weaving technique (percentages).

	Coarse-plaited	*Fine-plaited*	*Twined*
Rhythm			
1/1	54	27	67
2/2	22	67	29
2/1	15	3	0
irregular	8	3	5
Toe Shape			
square	20	12	0
round	14	12	26
contoured	42	35	34
angular contoured	24	18	3
jogged toe	1	24	37
Heel Shape			
round	54	30	81
square	46	70	19
Heel Selvage			
self	6	46	0
heel pad	79	38	0
heel pad variation	2	12	0
knotted	13	4	0
warp twined	0	0	100
Strap Material			
Yucca angustissima	86	66	0
coarse *Yucca* sp. fiber	14	32	45
fine *Yucca* sp. fiber	1	1	32
hide	0	1	23

toured toe with square heel (22 percent), contoured toe with round heel (19 percent), angular contoured toe with round heel (10 percent) and round toe with round heel (10 percent).

Temporal Variation in Sandals

Of the 406 sandals from Antelope House, 300 were found in dated Anasazi proveniences. The proportions of each weaving technique change over time, and the result of a chi-square test allows us to discard the null hypothesis that variation in sandal weave over time is due solely to chance (Table 110).

As there is only one Basketmaker III sandal (plain twined), nothing may be said with any assurance regarding BMIII sandals. The PI sandals represent the major weaving techniques: two fine-plaited, one coarse-plaited, one wicker, one diagonal twined, and one composite plain/diagonal twined.

There are 31 PII sandals, with coarse-plaiting (29 percent), twined (35 percent), and fine-plaiting (35 percent) approximately equally represented. There are no wicker sandals. A chi-square test indicates that although the number of coarse and fine-plaited sandals is about what would be expected, the number of twined is twice what would be expected.

There are 37 Early PIII sandals, and the three main weaving techniques are again equally prominent: 27 percent are coarse-plaited, 35 percent are twined, and 38 percent are fine-plaited. Twined sandals which are more than twice as common as expected, continue to be better represented than could be predicted in a situation governed by chance. Coarse-plaited sandals are less common than expected.

There are 54 Middle PIII sandals, of which 44 percent are coarse-plaited, 39 percent are fine-plaited and 17 percent are twined. The number of specimens of each weaving technique closely approximates the expected value.

There are 165 Late PIII sandals: 8 percent are twined, 43 percent are fine-plaited, and 48 percent are coarse-plaited. By this time, twined had become much less common than plaited. Anderson (1969: 129) suggests that coarse-plaited sandals were earlier than fine-plaited in the Tsegi area, but at Antelope House, coarse-plaited outnumber fine-plaited during Late PIII. The chi-square test shows that coarse-plaited are more common than expected, whereas fine-plaited are slightly less common than expected. Six wicker sandals were found in Late PIII proveniences. The sample, however, is too small to determine whether this occurrence indicates that wicker is characteristic of Late PIII or whether it is merely a product of the larger Late PIII sample.

Temporal variations in sandal weaving technique are due largely to increasing coarse-plaited and decreasing twined from PII to Late PIII. There is a disproportionately large number of undated twined sandals; although they make up only 19 percent of the collection, they constitute 29 percent of the undated specimens. Since many of the undated proveniences can be identified as earlier than Late PIII, the trend from twined to plaited sandals would be even more striking if all sandals had been dated.

Fine-plaited sandals most closely approximate the expected quantity per period. Figure 90 compares the proportions of fine-plaited, coarse-plaited and twined sandals found in proveniences dated from PII to Late PIII. Since the variables of rhythm, toe shape, heel shape and selvage have been shown to vary with weaving technique, the discussion of these sandal characteristics through time will be in terms of weaving technique. The wicker sandal collection is too small to be analyzed temporally and so will be excluded from the following discussion.

Coarse Plaited Sandals Through Time.

Temporal variation in coarse-plaited sandal characteristics is presented in Table 112. Weaving rhythm varies from predominantly 2/2 in PI-Early PIII to 1/1 in Middle and Late PIII. In Middle PIII, 2/1 is the second most common rhythm, and the usually common 2/2 is found in the fewest number of specimens. A chi-square test performed on rhythm over time for coarse-plaited sandals made it possible to discard the null hypothesis that variation was due only to chance (Table 110).

Toe shape is diverse but is not significantly different over time. The major variation is the lack of round toes in Middle PIII times. Heel shape variation over time is more pronounced (Table 110, 112). Round heels predominate in Middle PIII and square heels are more common in Early and Late PIII.

Variation in heel selvage is not significantly different over time. Heel pad selvages range from 82 percent to 83 percent, self selvages range

Table 112. Temporal variation in coarse-plaited sandals (percentages).

	PII-EPIII	*MPIII*	*LPIII*
Rhythm			
1/1	31	46	67
2/2	38	8	21
2/1	19	29	7
irregular	13	17	5
Toe Shape			
contoured	36	45	41
angular contoured	14	18	16
square	14	32	20
round	29	0	20
Heel Shape			
round	56	83	48
square	43	17	52
Heel Selvage			
heel pad	82	83	82
knotted	18	8	8
self	0	8	11
Strap Type			
edge loops	58	40	44
toe-heel loops	43	60	36

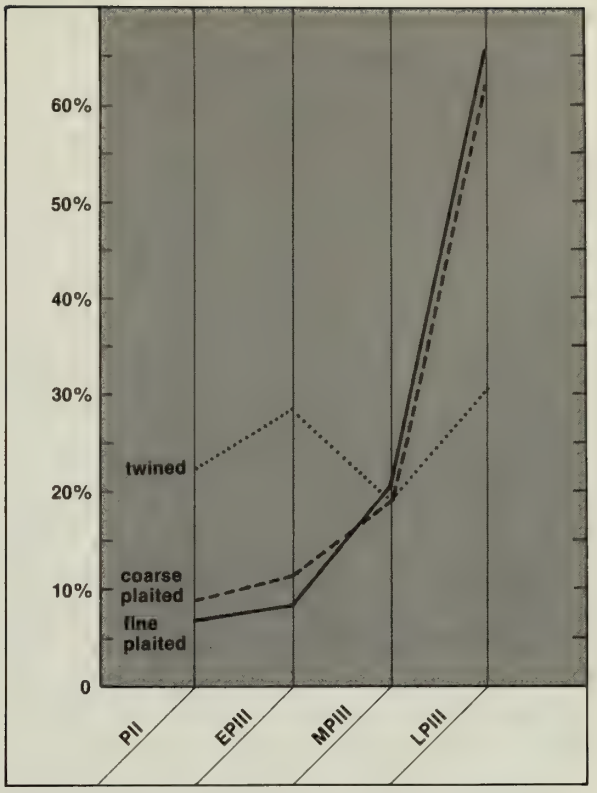


Figure 90. Proportions of coarse-plaited, fine-plaited and twined sandals from PII through Late PIII.

from 0 to 8 percent, and knotted selvages, the most variable, range from 8 percent to 18 percent.

Strap type varies from a predominance of edge loops in PII-Early PIII and Late PIII to a predominance of toe-heel loops in Middle PIII. Overlapping edge loops outnumber non-overlapping ones throughout the sequence. Again, this variation is not demonstrably significant.

Variation in coarse-plaited sandals generally is not statistically significant, except in the case of heel shape and weaving rhythm, neither of which is strongly significant. The greatest variation applies to Middle PIII sandals. Pueblo II-Early PIII and Late PIII sandals resemble each other more than they resemble Middle PIII sandals. In all characteristics examined for variation over time, Middle PIII diverges from earlier and later periods.

Fine-Plaited Sandals Through Time.

Temporal variation in fine-plaited sandal characteristics is presented in Table 113. Weaving rhythm does not vary through time on fine-plaited sandals. There are only 12 specimens with other than 2/2 rhythm and these are scattered at random through the various periods.

A chi-square test indicates that toe shape varies significantly through time (Table 110). The most obvious variation is in the large number of jogged toes, more than twice the number expected, from Middle PIII. Another deviation consists of more contoured and fewer jogged toes than expected during Late PIII. Heel shape is randomly various, with square heels ranging from 65 percent in early periods to 63 percent in Late PIII, and round ranging from 35 percent to 37 percent. Heel selvage exhibits greater temporal differences. Self selvages predominate in Middle PIII, whereas heel pads are most common in Late PIII. The variants in heel pad selvage appeared during Middle PIII times, when they were twice as common as in Late PIII.

Straps change very little from PI to Late PIII. Variation ranges from 33 percent edge loops and

Table 113. Temporal variation in fine-plaited sandals (percentages).

	PI-EPIII	*MPIII*	*LPIII*
Rhythm			
2/2	92	100	97
1/1	0	0	3
2/1	4	0	0
irregular	4	0	0
Toe Shape			
contoured	29	12	44
angular contoured	24	6	15
jogged toe	29	65	21
round	14	6	15
Heel Shape			
round	35	36	37
square	65	64	63
Heel Selvage			
heel pad	50	64	35
heel pad variation	50	9	46
self	0	27	12
Strap Type			
edge	37	33	39
toe	63	67	61

Table 114. Temporal variation in twined sandals (percentages).

	PI-EPII	*MPIII*	*LPIII*
Rhythm			
2/2	10	22	0
1/1	90	78	100
Toe Shape			
contoured	44	14	20
jogged toe	33	71	40
round	22	14	40
Heel Shape			
square	100	50	100
round	0	50	0
Heel Selvage			
warp twined	100	100	100
Strap Type			
edge loops	38	33	33
toe-heel loops	62	67	67

67 percent heel-toe loops in Middle PIII to 39 percent edge loops and 61 percent toe-heel loops in Late PIII. Overlapping edge loops are three times as common as non-overlapping edge loops throughout the sequence.

Fine-plaited sandals are much less variable over time than are coarse-plaited. Toe shape and heel selvages are the only characteristics which exhibit much variation and only the former is statistically significant. There appears to be a slight tendency for divergence between Middle and Late PIII sandals, but it is not nearly as strong as that in coarse-plaited sandals.

Twined Sandals Through Time.

Temporal variation in twined sandal characteristics is presented in Table 114. Twined sandals exhibit little variation through time. Weaving rhythm is homogeneous throughout the collection. Extant toes are few (21 examples), so that little may be said with assurance about change. However, there does seem to be a trend from contoured toes in PII-Early PIII to contoured with jogged toe in Middle PIII to Late PIII.

Heel shape shows a strong tendency toward round throughout the sequence, with the only three square heels dated Middle PIII. Heel selvages are all warp-twined. Straps are predominantly toe-heel loops from PII to Late PIII. Edge loops are most commonly overlapping. The two examples of non-overlapping edge loops are from PII proveniences.

The small degree of variability in the twined sandal collection may be explained solely by chance. There is some indication that Middle PIII sandals deviate from earlier and later sandals, since they possess the largest percentage of jogged toes and the only square heels. However, the sample size is quite small and the differences are not statistically significant.

Summary of Temporal Variation in Sandals.

The view that twined sandals are characteristic of Basketmaker and early Pueblo periods, while plaited sandals characterize the later Pueblo periods, has been substantiated at Antelope House. However, Anderson's suggestion (1959: 129) that coarse-plaited sandals are earlier than fine-plaited was not confirmed at Antelope House, where coarse-plaited became the dominant sandal type in Late PIII. Middle PIII stands out as a time of divergence in sandal characteristics.

Weaving rhythm, toe shape, heel shape, heel selvage and strap type for coarse-plaited sandals differ in Middle PIII from those of earlier and later sandals. This pattern of divergence is more weakly developed in fine-plaited sandals, in which toe shape and heel selvage are divergent in Middle PIII, and still more weakly in twined sandals, in which toe shape and heel shape of Middle PIII sandals vary most notably from other periods. The high proportion of jogged toe sandals in Middle PIII twined and fine-plaited sandals indicates that toe shape to be particularly common at that time.

Spatial Variation in Sandals

In view of the hypothesized social differences between the South and North Room Blocks, an attempt was made to distinguish stylistic variables which varied significantly between the two room blocks. Chi-square tests (Table 110) indicate that Late PIII coarse-plaited heel shapes are significantly different in the north (78 percent round) and south (71 percent square). Although the distribution of strap types by weaving technique and time may be explained by chance, strap types proved to be significantly variable across room blocks (Table 110). Toe-heel loops predominate (60 percent) in the South Room Block, while edge loops are more common (63–66 percent) in the North and Central Room Blocks. However, the other variables—weaving technique, toe shape, heel shape, heel selvage, border and strap material—are distributed randomly across the room blocks. Thus I was unable to substantiate the idea that the North and South Room Blocks diverged significantly in sandal characteristics.

Sandal Conclusions

The sandal collection from Antelope House is large and diverse and this diversity has been shown to be patterned. The variables of warp and weft material, weaving rhythm, toe shape, heel shape, heel selvage, border, strap type, strap material and fiber strap characteristics were studied in terms of their variation over time (BMIII–LPIII), space (North Room Block, South Room Block and Central Room Block) and weaving technique (coarse-plaited, fine-plaited, twined and wicker).

The greatest variation is found among weaving techniques. All variables, except fiber strap characteristics and strap types, are significantly different for the three major weaving techniques; wicker specimens are too few to allow generalization. In addition, strap type/strap material and heel selvage/heel shape are demonstrably correlated. There also is significant temporal variation. The largest number of sandals are fine-plaited, a weaving technique dominant prior to Middle PIII. Twined definitely is an early weaving technique and is most popular prior to Middle PIII. Coarse-plaited is a late type, dominant in Middle and Late PIII. In general, Middle PIII seems to be a time of change and experimentation in sandal manufacture. It is a time when older, established patterns disappear and when the trend begins toward styles prominent in Late PIII times, but it is also a time of unique traits. Coarse-plaited sandals are the most diverse of the three major weaving techniques, exhibiting significant variation over time in weaving rhythm, heel shape and heel selvage. Fine-plaited varies in toe shape over time, but twined is uniform through time.

Significant divergence in sandal characteristics across the three room blocks is minimal. Only strap type may be said to exhibit stylistic features explainable in terms of spatial differences. Late PIII coarse-plaited heel shapes also seem to vary across room blocks.

Thus weaving technique, time and, to a much smaller degree, space have been demonstrated to exert significant influence on a number of sandal traits.

Cordage and Knotted Yucca

Cordage and knotted yucca are discussed together because of their common functions as tying and securing materials. Knotted yucca refers to any unspun yucca leaf retaining fleshy parts which is knotted, looped or coiled. Bent yucca leaves are not included, although in many cases, these fragments may represent portions of larger looped or knotted specimens. Cordage is the term applied to any spun fiber. Cordage is further classified into twine and braid. Single-ply spun yarns are placed in the twine category, although they are not twined in manufacture.

All specimens were weighed to the nearest gram and classified according to material. A detailed study was conducted on a systematically drawn sample of cordage from Room 1 and of

knotted yucca from Rooms 1, 5, 16, 18 and 21. Only cordage and knotted yucca unassociated with artifacts are included in this analysis. The characteristics of cordage and knotted yucca in sandals, textiles and other vegetal artifacts are discussed in the analysis of those artifacts. The uses of cordage are discussed further in the subsections on the cotton and yucca behavioral chains.

Cordage

Braid.

Braiding involves passing each yarn diagonally over and under its fellow around and around the specimen (Kent 1957: 593). A total of 188 g of braid was recovered from Antelope House, 92 g of which come from dated Anasazi proveniences. The most common fiber found in braid is cotton (55 percent). The fiber constituency of braid is reported in Table 115. The small sample of 16 specimens subjected to detailed analysis contains 40 percent 3-strand, 27 percent 6-strand, 27 percent 8-strand, and 7 percent 12-strand braid. The 10 cotton braid specimens include 2-ply Z-spun S-twist fibers (6 cases), 2-ply S-spun Z-twist fibers (1), single-ply Z-spun fibers (2,) and single-ply S-spun fibers (1).

Table 115. Cordage recovery.

	Weight	*% of Total*
Braid		
cotton	103 g	54.8
yucca	43 g	22.9
bark	34 g	18.1
human hair	5 g	2.7
hair and yucca	3 g	1.6
Total	188 g	100.0
Twine		
yucca	5033 g	53.9
bark	377 g	4.0
cotton	335 g	3.6
human hair	42 g	0.5
sinew	8 g	0.09
animal hair	2 g	0.02
Zea mays	2 g	0.02
feather-wrapped yucca	2857 g	30.6
fur-wrapped yucca	484 g	5.2
feather & fur-wrapped yucca	168 g	1.8
fur-wrapped bark	26 g	0.3
hair-wrapped yucca	6 g	0.06
fur-wrapped cotton	1 g	0.01
Total	9341 g	100.0

Table 116. Twine characteristics.

	Cotton N/%	*Coarse Yucca N/%*	*Fine Yucca N/%*
Ply			
1	36/27	24/3	4/2
2	86/66	796/95	239/95
3	3/2	10/1	4/2
4	3/2	4/0.5	2/1
6	1/1	0	0
9	1/1	0	0
10	1/1	0	0
Spin			
S	10/8	511/61	90/36
Z	121/92	319/38	161/64
Spin/Twist			
SZ	8/8	504/63	89/36
ZS	86/91	296/37	157/64
ZZ	1/1	4/0.5	0
SS	0	1/0.1	1/0.4

Twine.

Twine is formed by twisting together two or more yarns. A total of 9440 g of twine was recovered, 5784 g of which come from dated Anasazi proveniences. The fiber constituency of twine is reported in Table 116.

Detailed examination of the twine sample from Room 1 (1235 specimens) indicates that ply, spin, reply and multi-twist are correlated with fiber material (see Tables 116, 117). Single-ply yarns are 56 percent cotton and probably represent unraveled twine, braid and textile components. Two-ply predominates in cotton and yucca twine (92 percent). Cotton ply is more diverse than is yucca, although the collection of cotton twine is smaller than that of yucca. Yucca twine ply ranges from one to four, while cotton includes these plus one instance each of 6-, 9-, and 10-ply. The variety of ply found in yucca twine from Antelope House is the same as that reported for Mug House yucca twine. The 40 cotton twine specimens from that site include only 1-, 2- and 3-ply (Rohn 1971: 114, 121). Cotton and fine yucca fiber are most commonly Z-spun, 92 percent of the former and 64 percent of the latter being so characterized. Coarse yucca fiber, on the other hand, is predominately (61 percent) S-spun. Generally, twist is in the opposite direction from spin. Only 0.6 percent of the collection violates this convention.

Table 117. Results of chi-square tests on twine.

Null Hypothesis	*Result*
1. Variation in twine ply (1, 2, 3, 4, 6–10) by material (coarse yucca fiber, fine yucca fiber, cotton) is due to chance.	P<.005
2. Variation in twine spin (S versus Z) by material is due to chance.	P<.005
3. Variation in twine reply (present, absent, doubled) by material is due to chance.	P<.005

Table 118. Characteristics of multi-twist twine.

	Cotton N/%	*Coarse Yucca N/%*	*Fine Yucca N/%*
Reply			
2	14/88	254/97	49/94
3	1/6	4/2	3/6
4	1/6	2/1	0
Spin/Twist			
ZS-Z	11/79	215/86	42/81
SZ-S	0	14/6	1/2
SZ-Z	0	7/3	3/6
ZS-S	0	5/2	2/4
ZZ-S	0	1/0.4	0
ZS-Z-S	0	1/0.4	1/2
SZ-S-Z	0	1/0.4	1/2
ZS-S-Z	3/21	0	0
ZS-Z-Z	0	5/2	2/4

More complex specimens are formed by replying two or more pieces of twine to create multi-twist cords. Whereas only 4 percent of the yucca and cotton twine from Mug House is multi-twist (Rohn 1971: 114), 27 percent from Antelope House is multi-twist. The most complex twine, making up 5 percent of the multi-twist specimens, is formed by twisting together two or three multi-twist cords. The characteristics of multi-twist cords are presented in Table 118. As with spin and twist, the norm is to alternate the direction of each subsequent twist. Ninety-one percent of the multi-twist cords follow this rule.

The bulk (79 percent) of the twine is unmodified, but 18 percent is knotted, 3 percent is looped and 0.4 percent is looped to form a chain. Knots include 13 percent overhand, 75 percent square, 6 percent granny, 1 percent slippery reef, 1 percent larkshead and 4 percent unclassified.

The sample from Room 1 includes only one bark fiber specimen and four of human hair. Therefore, it is not possible to generalize with assurance regarding the characteristics of such twine. The bark and hair specimens are 2-ply Z-spun, with three hair cords being 2-reply multi-twist.

Knotted Yucca

Knotted yucca is more common by weight than is cordage, totaling 15,988 g, 11,806 g of which come from dated Anasazi proveniences. The study sample of 1156 specimens indicates that the number of knotted yucca pieces is approximately equal to the total number of all types of twine. The knotted yucca collection is 63 percent knotted, 33 percent looped, 3 percent chain looped and 0.7 percent coiled.

Cordage and Knotted Yucca Over Time

The bulk of the cordage and knotted yucca comes from Late PIII proveniences (Table 119). However, the curves charting the relative percentages for yucca cordage and knotted yucca do not rise as sharply in Late PIII as do those for cotton and bark (Fig. 91). When the figures are corrected to reflect the variations in number and size of proveniences for each period, a decrease in the quantity of cotton and yucca in Middle PIII is evident (Table 120). Both the corrected figures and the percentage curves demonstrate that cotton fiber increases most dramatically very late at Antelope House. These findings agree with the temporal fluctuations observable in the combined total of artifactual and non-artifactual yucca and cotton, as charted by Ambrose (Chapter 10). Ambrose shows that the overall decrease in vegetal remains during Middle PIII coincides with a period of climatic desiccation.

Table 119. Twine material over time.

	Cotton Weight/%	*Yucca Weight/%*	*Bark Weight/%*	*Hair Weight/%*	*Total Weight*
BMIII-PI	< 1b/0.8	56g/94.2	2g/3.4	1g/1.7	59 g
PII	7g/1.1	6225g/97.2	11g/1.7	< 1g/0.1	640 g
EPIII	11g/2.5	424g/96.4	5g/1.1	0	440 g
MPIII	19g/1.9	990g/96.5	17g/1.7	< 1g/0.1	1026 g
LPIII	228g/6.2	3262g/89.0	164g/4.5	13g/0.4	3667 g

Figure 91. Proportions of cordage and knotted yucca through time.

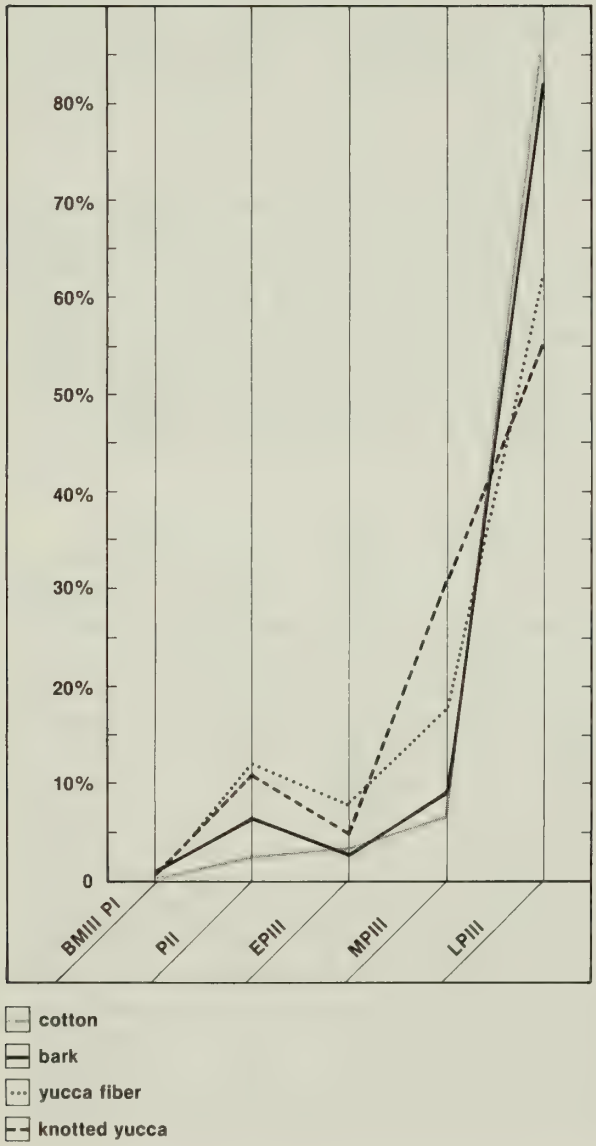


Table 120. Comparative percentages of twine fiber material and knotted yucca over time (from corrected volume figures).

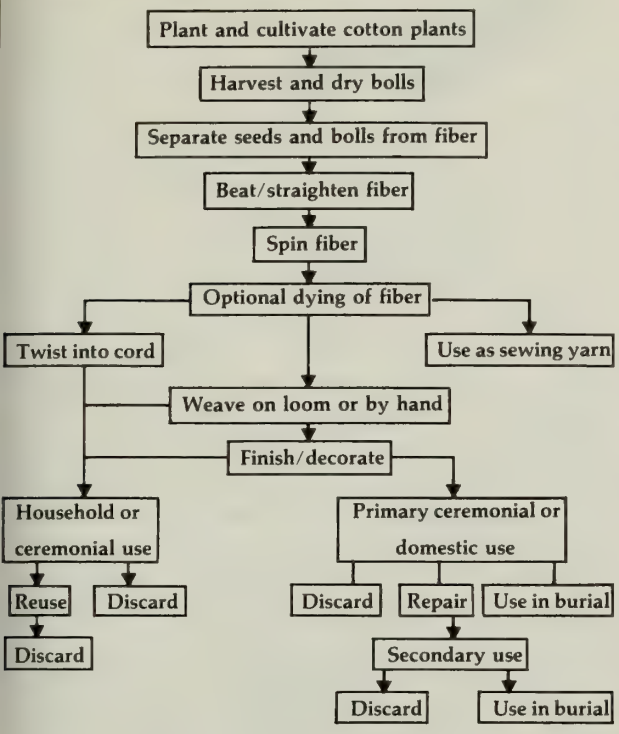
	Cotton	*Yucca Fiber*	*Bark*	*Yucca Leaf*
PII	.39	35.00	.62	70.74
EPIII	.54	20.74	.24	20.44
MPIII	.31	15.91	.27	50.19
LPIII	1.60	22.91	1.15	47.21

Cotton Behavioral Chain

A cotton behavioral chain model has been presented elsewhere (Magers 1975) as a tool for interpreting material culture remains in a way that will reveal the nature of the prehistoric behavioral system at Antelope House. The technique of behavioral chain analysis, formulated by Schiffer (1975), involves the development of an ethnographic model, tracing the sequence of activities, as well as attendant social relations and material products associated with some element during its life within the cultural system. In this case, the element to be traced is cotton. The cotton behavioral chain model is illustrated in Figure 92. The model may be used to test for evidence of the various cotton-related activities at Antelope House. The model is discussed in detail in the Magers article cited above, but certain aspects will be reviewed and amplified here.

Cotton could have been obtained by the inhabitants of Antelope House through local cultivation or through trade with cotton-growing regions to the south. Ethnographic data suggest that trade in cotton fiber, thread and finished cloth was common in the Southwest (Robbins 1916: 102; Beaglehole 1937: 82). While it is not possible to discard the possibility that de Chelly people received cotton from other areas, the pri-

Figure 92. Cotton fiber behavioral chain model.



mary source of cotton seems to have been local cultivation. The almost 2 kg of raw cotton fiber, seeds, bolls and other plant parts recovered from a 40 percent non-random sample of the vegetal refuse provides evidence for cultivation of cotton in the vicinity of Antelope House. The notion that cotton can be grown in de Chelly today was confirmed through experimental planting of cotton plants in 1973. No evidence is available regarding the techniques of cotton cultivation used prehistorically, but the presence of unruptured bolls in the unginned cotton suggests that cotton was harvested by picking the unruptured bolls.

The finding of one possible cotton beater suggests that such a tool may have aided the process of separating the cotton fibers from the other plant parts. The separated fiber was spun with the aid of a spindle. Some spun cotton was dyed. Approximately 20 percent of the cotton cordage was dyed red, brown, black or blue. The dyes have not been submitted to chemical analysis, but the deep saturation of the brown, black and blue dyes, as opposed to the more superficial quality of the red, suggests that the former are inorganic and that the latter is organic. The brown is especially well set. Attempts to remove it by soaking threads in ethyl alcohol were largely unsuccessful. Plants reported in the ethnographic literature as dye producers and recovered from Antelope House include *Helianthus* spp. and *Rhus trilobata* (blue and black), *Juglans major* (brown), *Celtis reticulata* (brown and red), *Cercocarpus* spp. and *Prunus virginiana* (red) (cf. Appendix F).

Some spun cotton was braided or twisted into twine; there are 439 g of cotton twine and braid in the cordage collection. Cordage was the versatile repair and construction material of the puebloans. Cotton cord has been found in utilitarian artifacts, such as bundles of yucca and twigs, as well as in presumably ceremonial objects. Historically, cotton has been important in Pueblo ceremonial life (Parsons 1939: 92, 172). Evidence of such ceremonial use of cotton at Antelope House consists of prayer feather holders of cotton twine and feather, as well as corn ears and corn cobs bound with cotton twine. Single-ply yarns generally were used for weaving. The loom anchors buried in the floors of several kivas and rooms and the approximately 1 m width of a number of plain weave blankets give evidence of the vertical loom. The presence of the belt loom may be inferred from the loincloths and the four complete battens under 40 cm in length. The square-ended braid fragments suggest the use of some kind of braiding frame. Other implements attesting to weaving include heddles, shed rods and sticks, finishing needles and weaving combs.

The warp and weft selvages of fabrics usually were finished by twining or overcasting. Post-loom decorative techniques include embroidery and painting on plain weave. The finished cloth sometimes was sewn into such articles as bags, while in other cases, such as blankets, the artifact was essentially finished on the loom. The loincloths and blankets were used in the daily life of the puebloans. On the other hand, two of the six cotton bags were found in a ceremonial basket, and a third bag also may be ceremonial, since it contained Rocky Mount bee plant seeds (*Cleome* sp.).

The presence of braided, warp-face plain weave, looped and tapestry specimens attests to the manufacture of non-loom textiles. Kent (1957: 527) suggests that such fabrics were made by women. Non-loom articles made partially or wholly of cotton include tumplines, belts, cradle

bands and socks. All of these non-loom articles are utilitarian.

The identification of textile manufacturing areas within the site was a task hampered by the paucity of primary and *de facto* refuse at Antelope House. However, analysis of the distribution of weaving, spinning and sewing tools and of raw cotton revealed a number of areas which may have been loci of weaving-related activities.

The ethnographic literature suggests the hypothesis that spinning and weaving were done in kivas (cf. Stephens 1936: 33). This hypothesis is substantiated by the evidence of such activities in four of the seven kivas. Loom anchors in place beneath the floor are the best evidence of weaving. Loom anchors were found *in situ* in Kiva A, Kiva 23 and Kiva 18. Kiva 42 has holes in the floor, which may have contained loom anchors at one time; a loom anchor was recovered from the trash of that kiva. Additional evidence of spinning and weaving of cotton in these four kivas includes weaving and sewing tools and more than 90 g of cotton within 10 cm on the floor of Kiva 23. Weaving tools and more than 31 g of cotton are associated with the floor in Kiva 18. Kiva 42 contained sewing and weaving tools in the trash. The other three kivas on the site contained little to indicate weaving activities.

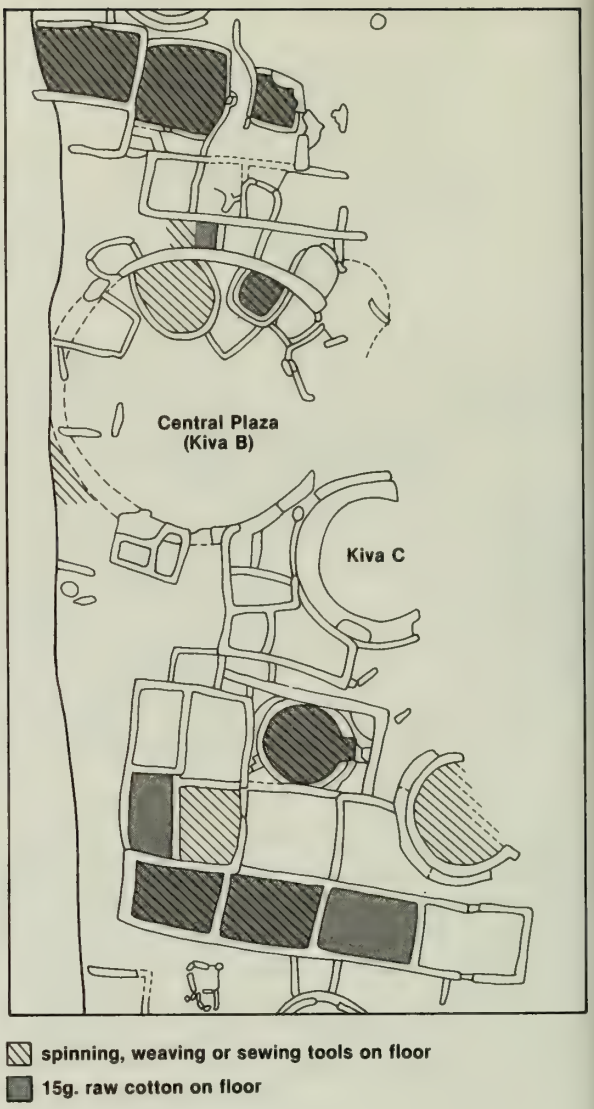


Figure 93. Areas of the site from which evidence of spinning and weaving was recovered.

Table 121. Summary of evidence for weaving activity areas.

Provenience	*Evidence*	*Date*
Kiva A	loom anchors in floor (kiva excavated in 1906—no data on fill)	LPIII
Kiva 23	4 loom anchors in floor; on floor: 1 shed rod, 1 shed stick, 2 finishing needles, 1 yucca needle, 90.3 g cotton; in trash: 1 finishing needle	LPIII
Kiva 18	8 loom anchors in floor; on floor: 1 finishing needle, 31.8 g cotton; in trash: 1 shed stick, 1 finishing needle, 2 yucca needles	LPIII
Kiva 42	5 loom holes; in trash: 1 loom anchor, 1 batten, 1 finishing needle, 1 yucca bundle	LPIII
Room 5, floor 1	on floor: 1 batten, 1 spindle, 35.4 g cotton; in trash: 4 shed sticks, 4 yucca needles, 1 thread bundle	LPIII
Room 41, floor 1	on floor: 2 shed sticks, 45.5 g cotton	LPIII

Kiva C trash included one spindle and Kiva D trash contained one shed stick. A heddle, two spindles and a yucca needle were found in the trash of Kiva 47. Two other rooms also contained evidence of weaving. Room 5, Floor 1, contained weaving and spinning tools and more than 35 g of cotton. The evidence for spinning and weaving is presented in Table 121 and is located within the site in Figure 93. Thus the ethnographic pattern of weaving activities associated with kivas seems to have applied prehistorically at Antelope House.

Woven fabrics that became worn through use were mended and patched. Forty-seven percent of the 336 textile fragments measuring at least 100 cm^2 are patched or mended. Kent (1957: 574) suggests that dyed threads were too valuable to be used in mending, but 24 percent of the repair threads are dyed, indicating little effort to conserve them. Brown and blue are the most common colors. Mending and patching material is 94 percent cotton, 5 percent yucca fiber and 1 percent yucca leaf, indicating that cotton was abundantly available for textile repair. Mending stitches on loom-woven textiles are 91 percent twined, with running, overcast, outline and saddler's stitches much less common. Patching stitches are 59 percent overcast and 25 percent running, with saddler's, outline and twined also used. Patching stitches are 88 percent twined and 6 percent running on finger weaves. Patching stitches, therefore, vary for loom and non-loom weaves, and stitches favored for mending differ from those favored for patching. Patching and mending behavior also varies according to weaving technique. Tapestry and non-loom weaves are not patched, but plain weave and twill are. Mending is more common than patching and is found in 80 percent of plain weave and non-loom textiles and in small proportions of twill and tapestry. Mending and patching were done with yucca-tip and wooden needles.

The multi-dimensional scaling clusters of selvage, mending and patching stitches suggest that the same people made and repaired the textiles. Ethnographically, it was the men who repaired textiles. Certain individuals apparently favored particular stitches, which they tended to use consistently whenever possible, regardless of the nature of the task.

Cotton blankets were found in two burials. One burial included two tumplines, as well as a carrying basket. Most of the rest of the Antelope House cotton textiles were found in secondary trash deposits. The textiles not placed in burials tended to be very worn and fragmentary and often showed use as swabs, pads and rags.

Ethnographic data suggest that textiles may have been traded to other pueblos. Woven goods played a large part historically in exchanges between the Hopi and other pueblos, the Havasupai, and the White Mountain Apache (Beaglehole 1937: 84). Trade generally is carried out on the dance court at Hopi, and the Central Plaza at Antelope House may have served a similar function. Beaglehole also mentions the trade of thread between kivas within and among villages, which would be conducive to the homogeneity of textile thread characteristics observed in the Antelope House collections.

The environmental constraints on cotton cultivation would have produced a situation in which the raw materials for textiles were not as generally available as were the raw materials required in pottery manufacture. This, coupled with the demonstrable presence of extensive pottery trade and the greater transportability of a non-breakable, more flexible and compactible product such as cotton, provides a sound basis for hypothesizing that the cotton trade in the Anasazi area was at least as widespread as the pottery trade. The distinctive features of the material remains of such a trading network would be explainable largely on the basis of the restricted number of exporters. While it is not possible to demonstrate that the textiles at Mesa Verde or the raw material for manufacturing them originated in de Chelly, it is possible to say that Mesa Verde pottery is present at Antelope House in PIII times. The ceramic evidence, in fact, suggests that there may have been an influx of Mesa Verde people into Antelope House in Late PIII (see Chapters 21 and 22). The earlier Mesa Verde ceramics at Antelope House, however, may be the result of a trading network in which pottery moved south from Mesa Verde and cotton moved north from de Chelly. These economic bonds may have led to social ties, including intermarriage. This social and economic interaction would have provided a basis on which the Mesa Verde people would have been welcomed as immigrants by their friends, trading partners and relatives in de Chelly.

The evidence presented above strongly sug-

gests that cotton cultivation and processing and the manufacture and trade of textiles were important parts of life at Antelope House. It is uncertain when this cotton complex developed. The earliest raw cotton and cotton twine date from BMIII proveniences and the earliest cotton textiles and weaving tools from PI. Cotton twine, textiles and weaving tools increase dramatically in Late PIII. The only *in situ* occurrence of loom anchors, evidencing the wide vertical loom, is Late PIII. All battens date prior to Middle PIII and are under 40 cm in complete length and would have been more useful on a narrow belt loom. Prior to Early PIII, the few cotton textiles are plain weave, braid or warp-face plain weave. Loom and non-loom tapestries make their first appearance in Early PIII. The first twills and the first identifiable blanket date to Middle PIII. These facts suggest that the weaving industry at Antelope House was essentially a PIII phenomenon, flowering very late and reaching a peak shortly before abandonment of the pueblo.

It is impossible to determine when the occupants of de Chelly began to cultivate cotton. On the basis of the overall evidence for cotton and its related activities, however, I suggest that extensive cotton cultivation did not begin until PIII. The BMIII, PI and PII cotton at Antelope House probably was acquired through trade, although it may represent the very beginnings of cotton cultivation in the area.

Yucca Behavioral Chain

Stier (1975) has developed a behavioral chain for yucca leaves and fruits, dealing mainly with the collecting and processing of these elements. I intend to expand the discussion of the role processed yucca leaves played in puebloan life. Figure 94 shows the ethnographically documented uses by Pueblo peoples of yucca leaves. Little specific information is available regarding the assignment of the task of manufacturing these objects. It is logical to infer that stringing of dried fruits and making of pot rests and brushes for painting pottery were women's tasks, since these artifacts are associated with women's work. Likewise, the stringing of bows and making of prayer sticks and other ceremonial objects are associated with the male domain. It has been suggested (Kent 1957: 527) that yucca sandals and finger-woven textiles, as well as baskets, were made by women.

Study of the archeological materials from Antelope House demonstrates the presence prehistorically of all the ethnographic uses of yucca leaves in artifacts. Additional uses of yucca are evidenced in the archeological remains and are presented in Table 122. The non-textile artifacts utilizing yucca are discussed in Chapter 19. The emphasis here will be on yucca textiles and sandals.

Before dealing with the artifacts, it is necessary to make some comments about yucca fiber. I distinguished two types of processed fiber: coarse and fine. The fine yucca fiber is so thoroughly mascerated or pounded that the fibers are as soft and fuzzy as cotton. This corresponds to Carolyn Osborne's Fiber Type C. Her Fiber Types A and B are classified as coarse fiber (Rohn 1971: 114). The coarse and fine fibers are physically distinguishable and appear to have been treated differently after processing. The Antelope House cordage collection indicates that fine and coarse yucca were spun, twisted and replied differently. In general, fine yucca more closely resembles cotton in its treatment. Cotton and fine yucca are 92 percent and 64 percent, respectively, Z-spun, while coarse yucca is 61 percent S-spun. Coarse yucca cordage is more commonly replied than expected, whereas both fine yucca and cotton have fewer instances of reply and more examples of no reply and of double reply than expected. The resemblance in spin between cotton and fine yucca fiber suggests the possibility that fine yucca may occasionally have been spun on a spindle like cotton, rather than by hand like coarse yucca fiber.

Table 122 demonstrates the different uses of fine and coarse yucca twine in non-textile artifacts. In finger-woven textiles, fine yucca again seems to be identified closely with cotton. Fine yucca is found as yarn in looping, as wefts and warps in warp-face plain weave and as wefts in slit tapestry and weft-twine. Cotton likewise is used as weft material for tapestry and weft-twined textiles. In contrast, coarse yucca appears as yarn in looping and as warps in slit tapestry, weft-twine and weft-wrapping. The same weft-warp differentiation is present in twined sandals, in which fine fiber is used for wefts and coarse fiber for warps.

Some insight into sandal manufacture is provided by the bundle pictured in Figure 95. This bundle includes an unfinished twined sandal,

Table 122. Archeological uses of yucca leaves.

Split Leaf

Plaited and wicker sandals
Plaited basketry and mats
Sandal ties and lacing
Netted rings
Brushes
Pot rests
Bowstrings and grips
Bindings on loom anchors, hafts, cradles, fetishes, rings, hoops
Repair sandals, pottery, and weft-twined robes

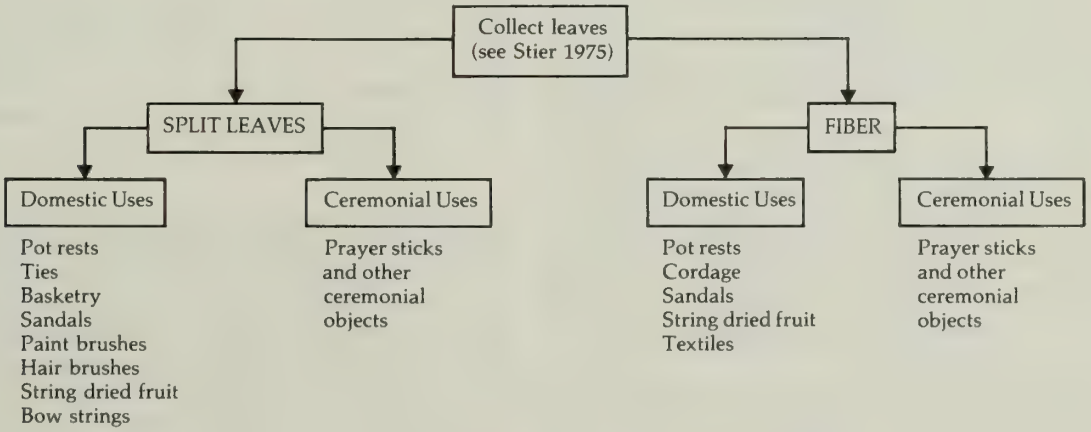
Processed Fiber

Unspun
Sandal pads
Pot rests

Coarse hand spun on knee (S/Z twist)
Twined sandal warps
Sandal ties
Weft-twine, tapestry, looping and weft-wrap
Yarns
God's Eye fetishes
Cordage
Feather holders
Nets
Netted rings
Strung vegetal matter
Swabs
Bindings on bundles, hafts, cradles, fetishes, rings and loops

Fine spindle spun (Z/S twist)
Tapestry, looping, weft-twine and warp-face
Plain weave yarns
Bow strings
Brushes
Repair pottery
Textiles and sandals
Cordage
Feather holders
Nets
Netted rings
Strung vegetal matter
Swabs
Bindings on bundles, hafts, cradles, fetishes, rings and loops

Figure 94. Ethnographic behavioral chain model for yucca leaves.



Sources: Robbins, *et at* 1916: 49-52
Stevenson 1915: 79
Whiting 1939: 71



Figure 95. Sandal manufacturing bundle from Antelope House.

bundles of coarse and fine yucca and unidentified bark fiber, and a bone scraper. The whole bundle is wrapped with a braided cord of coarse yucca, a hair cord and a *Yucca angustissima* leaf tie. The fine yucca (dyed white and yellow) and the brown bark cord are weft materials, and the coarse yucca twine is warp material. The banded design on the sandal created by the variation in weft color is shown in Figure 89. It is interesting to note that the bone scraper in the bundle is the kind described by Osborne (1965) as a yucca processing implement.

Spatial distribution of sandals figured in our effort to isolate deposits which might be indicative of nearby sandal manufacture. The majority of Antelope House sandals were found in secondary trash deposits in rooms and plazas. Only 17 percent were found in primary or *de facto* deposits (i.e., on or very near floors and in burials). Sandals found in primary deposits are listed in Table 123. Special attention was given to unfinished sandals and to those with mates. Proveniences with such sandals are listed in Table 124. Again, most unfinished sandals (82 percent) and those with mates (75 percent) occur in trash rather than on floors.

Regardless of the nature of the proveniences, 65 percent of the unfinished sandals come from the core of the South Room Block (Rooms 1, 2, 21, 29 and 30). Considering the South Room Block and the South Plaza as a whole, all but one unfinished sandal (from Room 5 in the North Room Block) were found in the southern portion of the site. The highest frequency of unfinished sandals is found in Room 21, but all of these are from trash. Room 29 has two unfinished sandals associated with Floor 5 and two sandal mates on Floor 4. Room 29 has 29 other complete or fragmentary sandals associated with its five floors.

Yucca raw materials and waste products (leaf fragments and fiber quids) associated with floors would be expected to co-occur with unfinished sandals if the refuse is primary. The proveniences producing large amounts of yucca and yucca bundles are presented in Table 125. Again,

Table 123. Sandals in primary contexts (0–10 cm above floors).

Room 2	**Room 33**
floor 1 — 2 sandals	floor 1 — 1 sandal
floor 2 — 1 sandal	**Room 35**
Room 17	floor 1 — 2 sandals
floor 1 — 1 sandal	floor 2 — 1 sandal
Room 18	**Room 36**
floor 1 — 1 sandal	floor 2 — 1 sandal
Room 21	**Room 41**
floor 1 — 1 sandal	floor 2 — 2 sandals
floor 2 — 2 sandals	**Room 46**
Room 23	floor 1 — 1 sandal
floor 1 — 1 sandal	**Room 48**
Room 25	burial 8 — 1 sandal
floor 1 — 1 sandal	**Room 57**
Room 29	floor 1 — 1 sandal
floor 1 — 1 sandal	**Room 79**
floor 2 — 5 sandals	floor 1 — 1 sandal
floor 3 — 2 sandals	**South Plaza**
floor 4 — 6 sandals	floor 1 — 1 sandal
floor 5 — 19 sandals	**Tower Corridor**
Room 30	floor 3 — 2 sandals
floor 2 — 3 sandals	**Kiva B Annex**
Room 31	floor 1 — 3 sandals
floor 1 — 1 sandal	floor 2 — 2 sandals

Table 124. Unfinished sandals and sandals with mates.

Room 1	**Room 29**
trash — 1 unfinished	floor 4 — 2 mates
Room 2	floor 5 — 2 unfinished
floor 1 — 1 unfinished	**Room 30**
floor 2 — 1 unfinished	trash — 2 unfinished
Room 5	**South Plaza**
trash — 1 unfinished	trash — 3 unfinished
Room 19	**Kiva B Annex**
trash — 2 mates	trash — 1 unfinished, 2 mates
Room 21	
trash — 5 unfinished, 2 mates	

Table 125. Recovery of yucca raw materials and wastes.

	Total Weight of Yucca Associated with Floors	*Number of Yucca Bundles*
Room 1	427.1 g	4 (trash)
Room 2	218.0 g	0
Room 5	502.8 g	0
Room 18	86.9 g	1 (trash)
Room 21	357.3 g	9 (trash)
Room 22	not analyzed	4 (trash)
Room 27	111.8 g	2 (fl. 1)
		1 (trash)
Room 29	2220.7 g	1 (fl. 1), 3 (fl. 5)
		2 (trash)
Room 30	169.6 g	1 (trash)
Room 41	211.7 g	0
South Plaza	68.3 g	6 (trash)
Central Plaza	88.5 g	2 (trash)

Room 29 is prominent, having the largest amount of yucca of any room at the site. Floors 2, 4 and 5 of that room yielded more than 100 g each, and there are three yucca bundles from Floor 6. This correlates well with the large number of sandals from floors in Room 29, especially Floor 5, which also yielded an unfinished sandal. Floor 5 also produced a large proportion of complete sandals (83 percent), but all of these show wear.

Room 21 is another area high in yucca associated with floors. Two unfinished sandals and a pair of sandals come from Middle PIII proveniences above Floor 3, the floor with the least yucca of all floors in that room. One unfinished sandal and four yucca bundles were found in the Late PIII trash above Floor 2, the floor in Room 21 with the most yucca.

Room 30, with its unfinished sandal in a Middle PIII provenience, has a large amount of yucca on the floors, especially the Middle PIII Floor 2.

An unfinished sandal and an unworn complete sandal, as well as 173.6 g of yucca, come from Floor 2 of Room 2. This is 80 percent of the yucca in critical proveniences from that room.

Thus, most of unfinished sandals, yucca raw materials, yucca waste products and yucca bundles were recovered from trash deposits unassociated with floors. However, the occurrence of large amounts of yucca and unfinished sandals in the trash of Rooms 1, 2, 21, 29 and 30 in the South Room Block suggest material from sandal manufacture or primary discard from a nearby manufacturing area. Given the nature of the trash deposits at Antelope House, however, little may be said with assurance about the loci of sandal manufacture.

Summary of Weaving at Antelope House

Analysis of textiles, sandals, cordage and weaving tools was directed toward revealing technical, spatial and temporal patterning. The repeated correlation of traits with specific weaving techniques in both sandals and textiles demonstrates the strong patterning of manufacturing behavior, despite the variety of techniques and elements available to the weaver. The testing of the four original hypotheses regarding weaving at Antelope House also revealed interesting behavioral patterns.

The first hypothesis proposed that Canyon de Chelly was a cotton-growing and textile manufacturing area. Evidence supporting this hypothesis came from several sources. The growing of cotton was suggested by the great quantity of raw cotton recovered. A 46 percent sample of vegetal refuse yielded 2 kg of cotton fiber, seeds and bolls. An experimental planting of cotton in 1973 substantiated the idea that cotton cultivation is feasible in the area. The necessary cultivating tools (digging sticks) are present in the artifact assemblage, and the 169 spinning and weaving tools recovered provide the required textile manufacturing equipment. Ginning is suggested by one possible cotton beater and

spinning by spindles. The 439 g of spun cotton threads, twine and braid attest to the presence of processed cotton, as do the 1178 specimens (totaling 157 m^2) of woven cotton cloth. Weaving is evidenced by loom parts (heddles, shed rods, shed sticks and loom anchors), as well as by battens, weaving combs and finishing needles. The evidence is ample, therefore, to support the hypothesized cotton growing and textile manufacturing.

The second hypothesis proposed that kiva groups produced stylistically distinct textiles. This hypothesis was based on the assumption that weaving was done in the kivas. The discovery of loom anchors and loom holes *in situ* in four kivas supports this assumption. Since most textiles were recovered in trash deposits in the rooms, it was necessary to look for spatial patterning of the textiles after their removal from the kivas. This required an attempt to link kivas and their textile products with residential areas, which necessitated a study of textile trait distribution and a search for spatial clusterings. The multi-dimensional scaling program revealed no spatial clusters. Comparisons of textile traits between the North and South Room Blocks were equally unsuccessful.

The testing of the second hypothesis was complicated by the difficulty of controlling for the important variables of kiva recruitment rules, residence rules, marriage rules and textile gift-giving patterns. If kiva groups did produce stylistically distinct textiles, no clusters would be discernible unless the residential units were endogamous or the social system was characterized by patrilocal patriclans. Therefore, failure to find stylistic clusters in the textiles may not be attributed to the absence of distinct kiva styles.

The third hypothesis proposed that the North and South Room Blocks were separate social units. This hypothesis is closely connected with the second one. The failure to find clusters of textile and sandal characteristics that could be spatially identified with the room blocks made it impossible to use textiles and sandals as evidence of a social dichotomy. The random distribution of traits across the room blocks may be related to possible non-localized clans or to one of the obscuring variables discussed for the second hypothesis. It was impossible, therefore, to really test this hypothesis.

The fourth hypothesis proposed that environmental stress during PIII times led to decreased use of cotton in non-essential tasks. Although after formulation of this hypothesis one of the assumptions on which it was based (i.e., that cotton was not a food crop) was proved false, the testing of this hypothesis resulted in some interesting observations on change in weaving over time.

Overall, there is evidence of increasing use of cotton over time, with the florescence of the cotton industry occurring in Late PIII times. Seventy-one percent of the weaving tools and cotton fabric and 86 percent of the cotton twine date from Late PIII. The use of cotton yarns in mending and patching increases from 29 percent in PII to 96 percent in Late PIII. There are a few exceptions to the general trend of increased cotton use: in Early PIII times, there is a slight dip in the number of cotton textiles; in Middle PIII, there is a slight decrease in the number of square meters of cotton cloth; and in Late PIII, there is a slight decrease in the proportion of cotton mending yarns. These indicators of decreased cotton use, however, are more than offset by contemporaneous indicators of increased cotton use.

The trend over time from twined to fine-plaited to coarse-plaited sandals may indicate decreased use of yucca in later periods, since the twining technique requires the most yucca and coarse-plaiting requires the least. Middle PIII emerges as a time of diversity, experimentation and change in sandal manufacture. Thus sandals and the use of yucca may be better indicators of environmental stress during PIII times than cotton and textiles.

Chapter 19

Miscellaneous Wooden and Vegetal Artifacts

The miscellaneous perishable artifacts are presented here in terms of functional tool assemblages. The two most coherent assemblages are ceremonial artifacts and subsistence tools. A third, more heterogeneous group of artifacts is consisdered under the heading of domestic and craft tools. Many of the artifacts in this category are multipurpose. A fourth artifact class is that of bundles and pads. These are mostly of uncertain function, but an attempt is made to discuss probable functions of certain artifacts. The balance of the wooden and vegetal artifacts are considered together under the heading of miscellaneous artifacts. These objects are of indeterminate or multiple functions. The worked twigs and bark in this section were sampled nonrandomly.

Table 126 presents a summary of the species used in the manufacture of vegetal artifacts from PII through late PIII times and the number of artifacts in which each was used, by period.

Ceremonial Artifacts

Artifacts were identified as ceremonial on the basis of their resemblance to ethnographically documented ceremonial objects (cf. Parsons 1939; Anderson 1969). Ceremonial artifacts are illustrated in Figure 96 and listed by period in Table 127.

Twenty-eight objects may be placed in the category of fetishes. The most common are owl fetishes. These were described by Earl Morris (1919:46) as flower-like ceremonial objects. The Navajo make identical fetishes, called"Bugaboo owls," which are used for good luck or to frighten naughty children (Kluckhohn, Hill and Kluckhohn 1971: 330–331). Owl fetishes consist of a cross-shaped head of two flat coils intertwined at right angles. The head is attached to a straight handle. There are 15 owl fetishes from Antelope House; 14 are constructed of split *Rhus trilobata*, one of which has a *Yucca angustissima* leaf wrapped around the handle for reinforcement. Another object, similar to the typical owl fetish, is made of a pair of crossed *Salix* sp. twigs bound perpendicularly to the end of a longer *Salix* twig, which forms a handle. The paired twigs are bound to the handle with split *Yucca baccata* leaf ties. Handles on owl fetishes range from 4.5 cm to 19.0 cm (mean = 9.7 cm) in length and from 0.4 cm to 0.9 cm (mean = 0.8 cm) in width. The size of the head coil varies from 4.2 cm to 8.0 cm by 2.0 cm to 3.2 cm.

Four objects resemble god's eyes. Two are of *Rhus triblobata* twigs crossed and wrapped with split *Rhus* to form a diamond-shaped object. One is composed of *Erotia lanata* twigs wrapped to form a diamond by a split *Yucca baccata* leaf. The fourth god's eye is a diamond-shaped wrapping of yucca cord with a *Yucca angustissima* leaf stuck through the diamond. The god's eyes range from 2.8 cm to 8.2 cm (mean = 5.4 cm) in length. Widths are 1.6 cm and 6.8 cm (mean = 3.0 cm).

Similar in form to both god's eyes and owl fetishes are three sets of crossed parallel sticks.

Table 126. Vegetal artifacts (cumulative).

A = no. of artifacts in which used
B = correct by no. using artifact
C = correct by vol. proveniences
D = percentage by time period (corrected)

		PII	*EPIII*	*MPIII*	*LPIII*	
Rhus trilobata	A	10	5	15	76	
	B	.270	.152	.326	.310	
	C	.699	.260	.419	.638	2.01
	D	(.347)	(.129)	(.208)	(.317)	
Populus sp.		11	28	39	103	
		.30	.848	.848	.420	
		.769	1.458	1.089	.864	4.18
		(.184)	(.349)	(.261)	(.207)	
Gossypium hirsutum		2	4	3	23	
		.054	.121	.065	.094	
		.140	.208	.084	.193	.625
		(.224)	(.333)	(.134)	(.309)	
Yucca baccata		19	33	68	151	
		.514	1.00	1.478	.616	
		.140	.208	.084	.193	.625
		(.224)	(.276)	(.306)	(.204)	
Sarcobatus vermiculatus		4	21	30	120	
		.108	.636	.652	.490	
		.280	1.090	.838	1.007	3.215
		(.087)	(.339)	(.261)	(.313)	
Populus wislizenii		1	3	18	48	
		.027	.091	.391	.196	
		.070	.156	.503	.403	1.132
		(.062)	(.138)	(.444)	(.356)	
Salix sp.		49	28	114	146	
9.29		1.324	.848	2.478	.596	
		3.427	1.454	3.184	1.225	
		(.369)	(.157)	(.343)	(.132)	
Yucca angustissima		9	8	25	100	
2.581		.243	.242	.543	.408	
		.629	.415	.698	.839	
		(.244)	(.161)	(.271)	(.325)	
Phragmites communis		18	23	53	184	
5.477		.486	.697	1.152	.751	
		1.259	1.194	1.480	1.544	
		(.230)	(.218)	(.270)	(.282)	
Yucca sp.		3	2	12	34	
.934		.081	.061	.261	.139	
		.210	.104	.335	.285	
		(.225)	(.111)	(.359)	(.305)	
Salix exigua		0	0	12	21	
		0	0	.261	.086	
		0	0	.335	.176	.513
				(.656)	(.344)	
Cercocarpus sp.		1	29	3	14	
		.027	.879	.065	.057	
		.070	1.506	.084	.117	2.401
		(.029)	(.627)	(.035)	(.049)	
Populus tremuloides		7	29	16	45	
		.027	.879	.065	.057	
		.480	1.506	.447	.378	2.821
		(.174)	(.534)	(.158)	(.134)	

continued

Table 126. Vegetal artifacts (cumulative)—Continued

A = no. of artifacts in which used
B = correct by no. using artifact
C = correct by vol. proveniences
D = percentage by time period (corrected)

	PII	*EPIII*	*MPIII*	*LPIII*	
Zea mays	16	28	49	204	
	.432	.848	1.065	.833	
	1.119	1.454	1.369	1.712	5.654
	(.198)	(.257)	(.242)	(.303)	
Acer negundo	3	5	15	81	
	.081	.152	.326	.331	
	.210	.260	.419	.680	1.569
	(.134)	(.166)	(.267)	(.433)	
Juniperus sp.	4	5	12	38	
	.108	.152	.261	.155	
	.280	.260	.335	.319	1.194
	(.235)	(.218)	(.281)	(.267)	

Figure 96. Ceremonial artifacts from Antelope House: (a) Zea mays cob on a shaft, (b) Zea mays cob on a feather quill (both possible prayer sticks or darts), (c) feather hafted to Sarcobatus vermiculatus twig (possible prayer stick), (d and e) split Phragmites communis dice, (f) Acer negundo die, (g) bundle of split Phragmites communis dice, (h) P. communis cigarette, (i) bundle of Huatinea sp. feathers, (j) bundle of turkey feathers, (k) Yucca sp. prayer feather holder, (l) Phragmites communis bound with cotton textile (possible prayer stick or drumstick), (m) Populus sp. drumstick, (n) Yucca angustissima god's eye fetish, (p) Rhus trilobata triangular fetish, (q) R. trilobata owl fetish, (r) Populus sp. bird effigy, (s) Juniperus sp. lightning effigy, (t) Amelanchier utahensis roundel prayer stick, (u) Quercus gambelii crook prayer stick and (v) Cercocarpus sp. crook prayer stick.

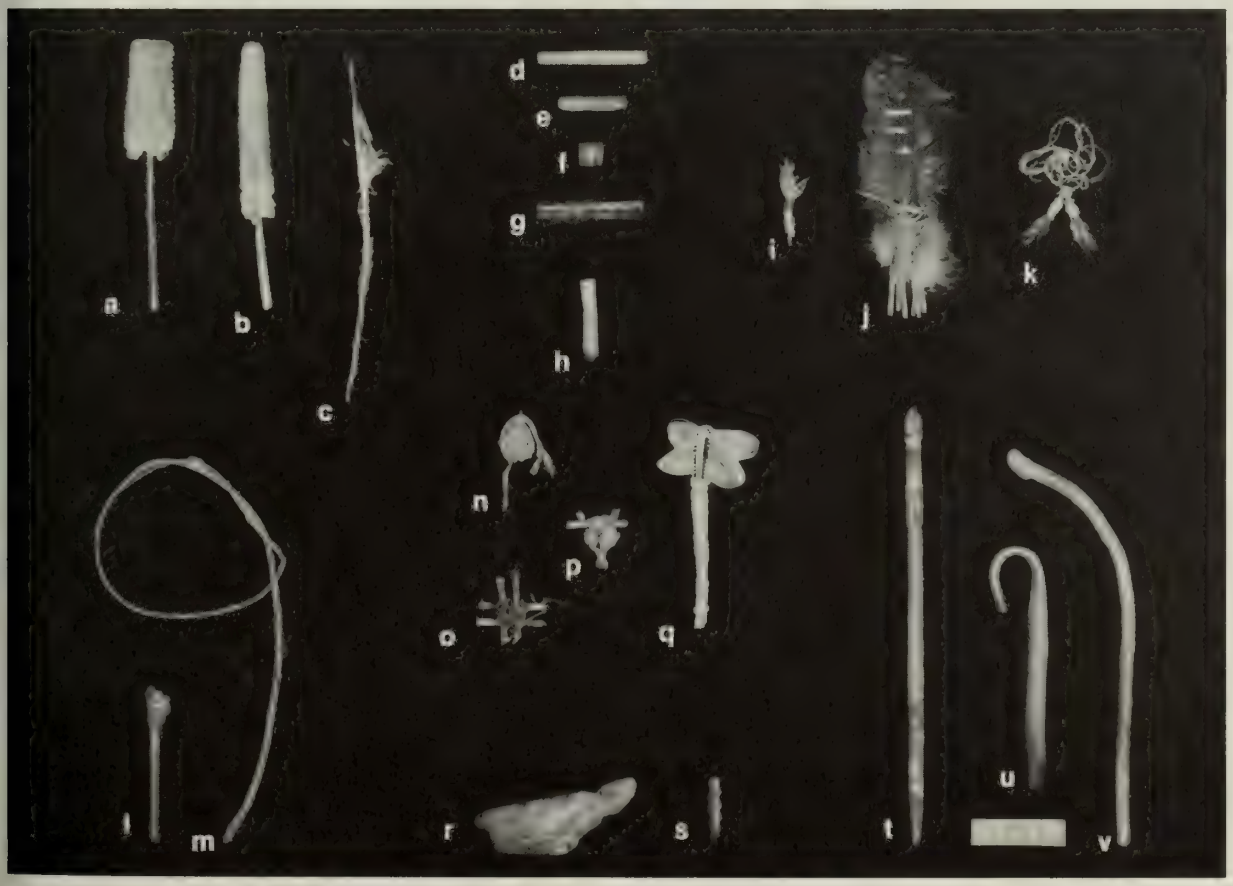


Table 127. Ceremonial artifacts over time.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*
Fetishes	2	4	1	8	11
Feather holders	0	0	2	4	9
Bound feathers	0	0	0	2	3
Prayer sticks	0	4	7	7	63
Bound corn cobs	0	0	1	0	0
Effigies	0	0	0	0	2
Drum sticks	0	0	1	1	2
Cigarettes	0	0	4	5	33
Dice	0	1	0	2	28

Two are made of two pairs of crossed *Populus* sp. twigs bound with *Salix* sp. bark strips; these measure 5.0 cm by 4.6 cm and 6.6 cm by 2.0 cm. The third is made of two pairs of crossed *Sarcobatus vermiculatus* twigs bound with split *Yucca baccata* leaf. This fetish measures 4.2 cm by 3.9 cm. Another possible fetish of similar manufacture consists of a small twig bound to a longer twig. The result is an object resembling a cross. The twigs are *Salix* sp. and the binding is yucca cord. The fetish measures 5.0 cm (L) x 1.0 cm (W) x 0.7 cm (Th).

Five objects, referred to here as triangle fetishes, are made of three small twigs bound together to form a triangle. Anderson (1969: 103) describes similar objects as fetishes, but these triangle fetishes are much larger than Antelope House specimens. The latter range from 2.0 cm to 3.8 cm in length, with a mean of 2.5 cm along the long dimension; Anderson's triangles measure 11.5 cm to 12.7 cm in length. Each triangle is made of a slightly different combination of materials: *Salix amygdaloides* bound with split *Salix amygdaloides, Salix* sp. bound with split *Salix* sp., *Salix* sp. bound with split *Rhus trilobata, Rhus trilobata* bound with *Yucca* sp. leaf, and *Quercus gambelii* bound with split *Rhus trilobata.*

Feathers, alone or on other objects, are ubiquitous ceremonial items among the pueblos (Parsons 1939: 285); therefore, any feather treated in some special way has been classed here as a ceremonial item. Seven feathers are bound with some kind of tie. Five feathers were treated individually: two are bound at the base of the quill, two are folded and bound medially and one unmodified feather is tied medially. Another artifact consists of two perforated quills of *Meleagris gallopavo* strung with brown-dyed cotton cord. The binding material is split *Yucca baccata* leaf in two cases and *Yucca* sp. cord in five cases.

There are 26 prayer feather holders, six of which are complete. Prayer feather holders are made of cordage, coiled and overhand knotted to form short, tight springy coils (0.3 cm to 1.0 cm long), into which small feathers are stuck. The coils are made separately and then gathered into a bundle of from 12 to 16 coils. At approximately 3 cm from the tip of the coils the group is bound together with a cord tie, which is sometimes the end cord of one of the coils. The other end cords of the coils are then twined, as in nine cases, or braided, as in two cases. The complete feather holders range in length from 13.0 cm to 20.0 cm (mean = 16.6 cm). The cordage is 75 percent yucca, 18 percent cotton and 7 percent bark fiber. Two ply is the dominant (93 percent) type, with a few instances of single-ply.

Four types of prayer sticks or pahos, were found at Antelope House. Prayer sticks are placed at all Hopi ceremonies and in diverse places--fields, springs, houses, kivas, shrines and altars (Parsons 1939: 270). An arrow paho consists of a turkey feather hafted onto a pointed stick of *Sarcobatus vermiculatus* bound with split *Yucca baccata* ties. The paho is 22 cm long. Two objects might be called string pahos. One is an unidentified twig with flat ends, which is bound in three places with sinew. The sinew binding on one end catches a long yucca cord. The second object consists of a yucca cord wrapped around a *Sarcobatus vermiculatus* twig and a *Phragmites communis* stem. The twig is tied at both ends and the reed is strung on the cord and tied on the exterior. Five pahos are in the form of crooks. Two are complete and measure 26.4 cm and 15.2 cm long. Crook paho diameters range from 0.9 cm to 3.4 cm (mean = 1.6 cm). The crook sections are polished and cut to form a flat cross section. In two cases, there are grooves at the end of the curved portion. Crook pahos are made of *Quercus gambelii* (2), *Sarcobatus vermiculatus* (1), *Rhus trilobata* (1) and unidentified wood species (1).

The 15 rounded pahos are straight sticks with one pointed end and a head which is bifacially beveled and which possesses one or more carved bands, often with bark present. The topmost band occurs about 5.0 cm from the head. Nine of the rounded pahos are complete and their length ranges from 16 cm to 51 cm (mean = 29.2 cm). Diameters vary from 0.9 cm to 2.4

cm (mean = 1.4 cm). These pahos are made of *Salix* sp. (6), *Amelanchier utahensis* (4), Salicaceae (2), *Populus wislizenii* (1), *Acer negundo* (1) and unidentified wood species (1).

Seventy corn cobs have been pierced with sticks of feather quills. The function of these cobs with shafts is problematical. They resemble darts used in ritual and non-ritual hoop games (Parsons 1939: 870; Culin 1907: 425); the darts, however, usually have multiple shafts extending all the way through the cob, so that they stick out at both ends. These features are not characteristic of Antelope House specimens. Corn cobs have also been used as bunts for bird arrows (Anderson 1969: 159), but the Antelope House artifacts do not seem well suited as arrows. Most are too short; length ranges from 5.5 cm to 31.0 cm (mean = 14.7 cm). The shaft extends out from the cob between 1.3 cm and 20.6 cm (mean = 6.2 cm). Shaft materials include feather quill (2), *Salix* sp. (12), *Salix exigua* (3),*Salix laevigta* (1), *Sarcobatus vermiculatus* (9), *Rhus trilobata* (7), *Populus* sp. (6), *Populus wislizenii* (1), *Juniperus* sp. (4), Nolina (3), Salicaceae (3), *Fendlera rupicola* (2), *Quercus turbinella* (1), *Erotia lanata* (1), *Cercocarpus* sp. (1), *Acer negundo* (1), *Sarcobatus* and *Pseudotsuga/Pinus ponderosa* (1), *Sarcobatus* and *Phragmites communis* and feather quill (1), and unidentified wood species (2).

Three corn cobs have bindings, one of *Yucca baccata*, one of unidentified bark and one of cotton. The cotton binding, especially, suggests a ceremonial context for the cob with shaft, due to the ceremonial importance of cotton.

There are three effigy-like artifacts. One is a bird carved of *Populus* sp. and covered with pitch. No details are depicted, only the form of the body, head, tail, and feet. It is 10.2 cm long, 3.4 cm wide and 2.8 cm thick. A zigzag carving of *Juniperus* sp. may be a lightning effigy. It measures 4.2 cm long, 1.0 cm wide and 0.5 cm thick. An artifact composed of a fragment of plain weave cotton cloth enclosed between two smooth rectangular tablets of *Pòpulus* sp. may be a highly stylized babe-in-cradle. Babes-in cradles occur on handles of 12th to 14th century Kayenta pottery (Morss 1954: 39). Toy wooden cradles were made at Zuni historically (Stevenson 1883: 372). Babes-in-cradles are used by contemporary pueblos as fertility symbols and as toys for little girls (Morss 1954: 53–54). The Antelope House babe-in cradle is 7.5 cm long, 4.2 cm wide and 1.4 cm thick.

There are four drumsticks, which are slender twigs bent into a loop at one end. The diameters of the loops range from 4.5 cm to 10.2 cm, (mean = 7.7 cm). Length varies from 15.5 cm to 26.3 cm (mean = 19.3 cm). Two drumsticks are *Populus* sp., one is *Salix* sp. and one is Salicaceae. Another possible drumstick, or prayer stick, is a *Phragmites communis* reed bound on one end with a fragment of plainweave cotton cloth with a split *Yucca baccata* tie. The stick is 9.5 cm long.

There are 51 cigarettes made of segments of *Phragmites communis* cut on one end and burned on the other. Such cigarettes are used ritually by the Zuni and the Hopi. At Zuni, they are thought to clear the path for prayer (Cush 1920: 162; Stephen 1936: 75). Cigarettes have smoked interiors and occasionally contain remnants of unidentified burned organic matter. All but two cigarettes bear a node and 69 percent of these have been perforated. Cigarette fragments vary in length from 2.4 cm to 7.9.cm (mean = 3.7 cm) and in diameter from 0.6 cm to 1.1 cm (mean = 0.9 cm).

Dice are known ethnographically in both sacred and secular contexts (Culin 1907: 95–162). Dice are made of wood or reed. The 26 wooden dice are short, bisected cylinders with flat ends. Designs are on the convex face, except for two that have designs on the ends. The end designs are perforated V-shaped motifs. Designs on convex faces include parallel lines (5 cases), a series of X's (4), parallel lines flanked by dots (1), ticked parallel lines (1), crosses (1), interlocking keys and transverse bands (1) and V's (1). These motifs are burned (73 percent), incised (20 percent) or abraded (7 percent). Wooden dice measure 0.7 cm to 2.1 cm (mean = 1.4 cm) long, 0.7 cm to 2.0 cm (mean = 1.3 cm) wide and 0.4 cm to 1.4 cm (mean = 1.1 cm) thick. Materials used in wooden dice are *Acer negundo* (22), *Quercus gambelii* (1), *Populus* sp. (1), *Prunus* (1) and unidentified soft wood species (1).

Fifteen dice are made of split *Phragmites communis*. These range in length from 1.6 cm to 13.3 cm (mean = 7.7 cm) and in diameter from 0.7 cm to 1.1 cm (mean = 0.9 cm). Seven have designs on the convex surface; five are burned and two are incised. Motifs are parallel lines and bands (2), ticked parallel lines (2), bands (1), dots (1) and parallel lines and dots (1). A group of five dice were tied togther in a bundle with a shredded *Juniperus* sp. bark tie.

Two ceremonial caches were discovered *in*

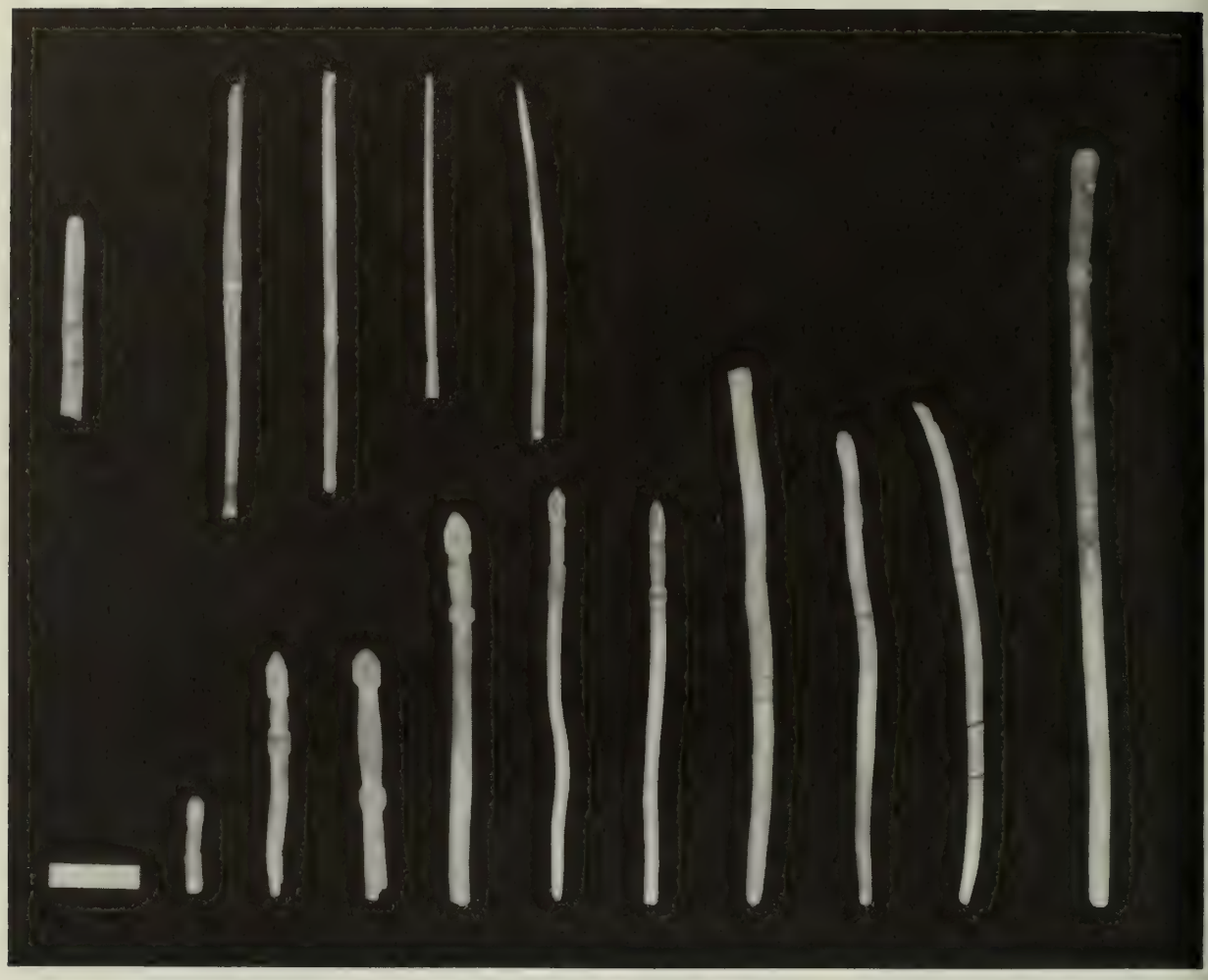


Figure 97. Ceremonial cache from Antelope House: (from top left) Quercus sp. shed rod, two Phragmites communis arrow shafts, P. communis and Sarcobatus vermiculatus arrow shaft and point, and S. vermiculatus arrow point; (bottom row) Amelanchier utahensis and Quercus sp. roundel prayer sticks.

Figure 99. Hide bag from Room 88 basket.



situ, but the bulk of the artifacts were in secondary deposits. Large quantities of ceremonial objects are associated with proveniences producing large amount of vegetal trash in general, such as Room 1 (34 ceremonial artifacts), South Plaza (28), Room 21 (26) and Tower Corridor (20). The ceremonial objects were not commonly part of the trash fill of kivas, but there are proveniences in Kivas 18 and 23 which may be significant in terms of the presence of ceremonial objects. Kiva 18 has two corn cobs with shafts, one owl fetish and one die on the floor, as well as another corn cob with shaft and a strung-feather bundle in the



Figure 98. Multiple technique textile wrapping from basket recovered from Room 88.

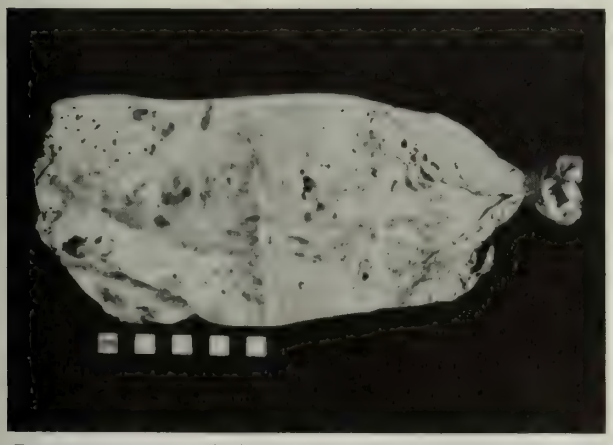


Figure 100. Empty hide bag from Room 88 basket.

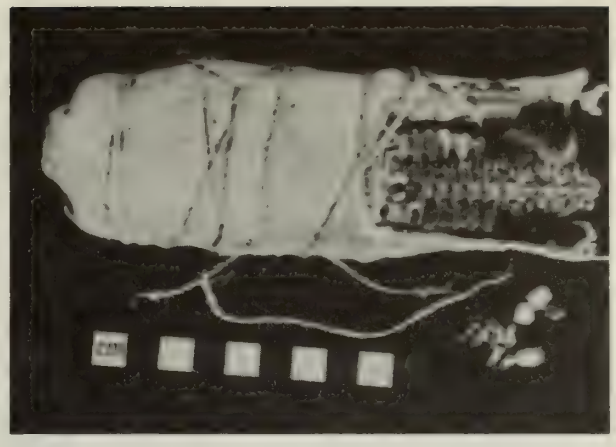


Figure 101. Sacred corn ear with hide wrapping from Room 88 basket.



Figure 102. Remains of hide bag with squash seeds from Room 88 basket.

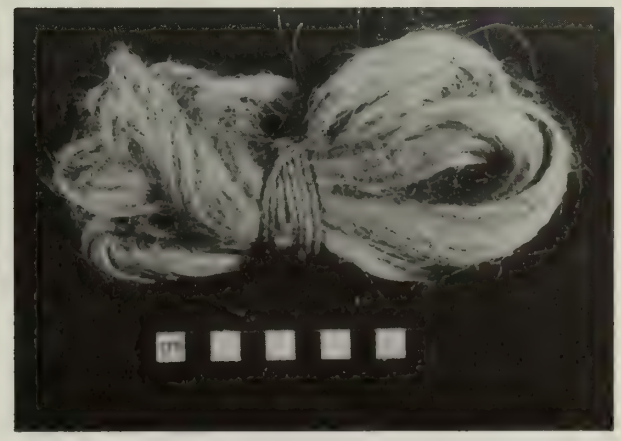


Figure 103. Yucca fiber bundle from Room 88 basket.

trash. The small space called Room 19, which is merely the corner left over when Room 47 was built, has a fetish and three dice in its fill. Kiva 25 has a die and a bound feather on the floor, as well as another die, a cigarette and a corn cob with shaft in the fill.

The two Late PIII caches of ceremonial objects are in Structure 81 in the northwest corner of the Tower Corridor and in Room 88 in the South Plaza. Inside Structure 81 was a slab-lined hatch containing many polished stones and, in the northeast corner, a bundle composed of 19 pahos, four arrows and two shed sticks (Fig. 97). Other ceremonial artifacts were found in the vicinity of Structure 81. A corrugated jar containing salt crystals was found just east of Structure 81, and a sacred corn ear bundle was discovered nearby. The Structure 81 bundle is a corn ear bound with a Z-spun cotton yarn and placed in a hide bag container. The corn ear bundle is 11.5 cm long and 7.0 cm in diameter. The hide container is stiched with saddler's stitches in cotton thread. The hide container was pulled down partway to reveal the top third of the corn cob. The corn ear bundle resembles one of the bundles in the ceremonial basket from Room 88.

The basket from Room 88 was discovered with a textile wrapping (see Fig. 65, 66 and 98 through 103). The textile wrapping measures 64 cm by 39 cm and is made up of 24 pieces of textile scrap, involving three different weaving techniques: plain weave, twill and looping. The cover was tied to the basket by yucca cords attached to the four corners of the cloth. These cords were wrapped around the basket and knotted in a complex manner, involving nine square knots. The basket itself is discussed by Adovasio (Chapter 20). Inside the basket were five hide containers, two cotton bags, three yucca fiber bundles, one sinew bundle, one prayer feather holder, one *Melongena patula* shell whistle, one bone awl and three loose yucca seeds.

The uppermost item on the basket was an empty hide bag (F.S. 1292). The bag is 30.0 cm long and 13.8 cm wide. It is stitched along the bottom with overcast stitches in yucca fiber yarn. Since there is no stitching up the sides, the bag must have been made from the leg skin of the animal. The mouth of the bag was closed by wrapping with yucca cord. Underneath this empty hide bag was a hide-wrapped ear of corn (F.S. 1299). The hide wrapping was not sewn, but was bound in place with yucca cord. The piece of hide wrapping is triangular and is 33.0 cm long and 15.0 cm wide. Inside the hide wrapping were a corn ear, a stone cylinder, a prayer feather holder and three shell beads.

The corn ear is a "perfect ear" by Hopi criteria; that is, the tip of the ear is covered by fully-developed kernels (Hugh Cutler 1972: personal communication). The ear is wrapped medially with yucca and cotton yarns, which catch several macaw body feathers in their bindings. The cotton string has a roughly triangular turquoise bead (0.5 cm by 0.3 cm) threaded on it. A bark cord attaches the corn ear to a polished hematite cylinder. The cylinder tapers slightly toward each end and is 9.2 cm long and 1.1 cm at its maximum diameter. A cotton string binds feathers to the cylinder. The prayer feather holder is composed of four fragments, which were probably twined together originally. The holder would have had eight feather-holding spring coils. Loose in the bundle and laying near the top of the ear of corn were three tubular white shell beads, 0.6 cm to 0.7 cm long and 0.4 cm to 0.6 cm in diameter.

The third hide bag (F.S. 1296) in the basket is 16.0 cm long and 7.5 cm wide. It is fragmentary, consisting only of a flat piece with the top opening and yucca cord tie present. Laying on the hide fragment were 414 squash seeds (72.8 grams).

The fourth hide bag (F.S. 1298) is an empty pear-shaped container. The bag is 12.6 cm long and 6.0 cm wide and is made of two pieces of hide sewn up the sides and along the bottom with saddler's stitches in yucca yarn. Two bark cords were passed through holes in the hide and knotted at the neck and base of the bag. The cord at the neck was bound around the opening to close it. The function of the cord at the base is uncertain.

The fifth hide container (F.S. 1308), attached by a yucca cord to a cotton textile bag described earlier, is just a rectangular piece of hide bound with a yucca cord. The tied bundle measures 16.5 cm long and 5.0 cm in diameter. This piece of hide was folded around four prayer feather holders. Attached to the mouth of the textile bag was a yucca cord, which was originally knotted to the binding cord of the associated hide container. Inside the cotton bag were a twig bundle and a hide bundle. The twig bundle is composed of three twigs and is 3 cm long and wrapped with yucca cord. The bundle shows indications of having been originally painted red. The hide bundle consists of a triangular piece of hide 8.5 cm long, with one edge elongated and Z-twisted to form the tie (25.0 cm long). The bundle itself measures

5.5 cm long and 2.5 cm in diameter. The bundle contained five nodules of tan shale, 25 fragments of dull green turquoise, two dark green unfaceted copper carbonate nodules, two *Cucurbita pepo* seeds and one unidentified root segment (1.6 cm long). None of the turquoise fragments are completely worked, but 20 of them show at least one smooth facet.

The other plain weave cotton bag (F.S. 1307) in the basket was folded twice to form a bundle 10.0 cm long and was bound medially with bark yarn and a hide strip. The hide strip itself ends in a small bundle (1.6 by 2.1 cm), which is tied off with yucca cord. Inside this hide bundle were 1.7 g of crushed garnet-hematite. The contents of the cloth bag consisted of eight azurite nodules, a string of quartz crystals, a root bundle and a skein of cotton yarn. The cotton yarn is Z-spun and formed a folded bundle 7.0 cm long and 1.7 cm wide. The root bundle, composed of four unidentified root segments tied together with yucca cord, measures 5.5 cm long and 2.0 cm in diameter. The azurite nodules range in size from 1.4 cm by 0.9 cm to 0.7 cm by 0.5 cm. The string of crystals consists of 11 well-formed quartz crystals, ranging in length from 2.2 cm to 4.0 cm and with an average diameter of 0.6 cm. They are bound to a connecting strand with sinew. The connecting strand is 42.5 cm long and consists of 4-ply Z-spun S-twist, 4-reply Z-twist bark cord 0.5 cm in diameter. There are one large yucca fiber bundle and two small ones. The large one is 17.0 cm long, 8.5 cm wide and 6.0 cm thick. It is bound medially with yucca cord and secured with a square knot. The second yucca bundle is a hank of 2-ply Z-spun S-twist cord, knotted with an overhand knot to form a bundle 8.5 cm long, 4.2 cm wide and 2.5 cm thick. The third yucca bundle is actually composed of three smaller bundles bound together with a yucca wrapping cord. The overall bundle is 4.5 cm long and 3.0 cm in diameter. The final object in the ceremonial basket is a figure-8 sinew bundle bound medially with one end of the sinew. It measures 9.5 cm long and 2.5 cm wide.

Subsistence Tools

Subsistence activities, such as hunting, gathering of wild plants and cultivation of domestic crops, are represented in the artifactual assemblage. Hunting tools are shown in Figure 104 and agricultural tools in Figure 105. Hunting is evidenced by bows, arrows, nets and throwing sticks. Arrows are found throughout the sequence from PI to PIII, but the other hunting tools are limited to PIII (Table 128).

Table 128. Subsistence tools over time.

	PI	*PIII*	*EPIII*	*MPIII*	*LPIII*
Arrow points (wooden)	4	8	29	17	53
Arrow shafts	1	8	7	23	99
Bows	0	0	0	1	9
Nets	0	0	0	0	2
Digging sticks	1	4	3	6	8
Hoes	0	1	0	1	0

There are fragments of 15 bows, but no complete bows. One is a nearly complete miniature, measuring 35.5 cm long. Seven are bow ends under 10 cm in length. The two largest bow fragments are both 27 cm long. Width and thickness are fairly uniform for all bow specimens; width varies from 0.9 cm to 1.7 cm (mean = 1.3 cm) and thickness varies from 0.5 cm to 1.3 cm (mean = 0.7 cm). The bows are made of slender branches, which have been peeled (in all but one instance), cut, split (in three cases), bent into a shallow arc and generally smoothed or polished. The cross section is usually plano-convex, although one specimen is oval and three are rectangular. The ends are flat in 62 percent of the cases and round in 38 percent. There is evidence of binding on four bows. One shows discoloration at four regularly spaced intervals, indicating the former presence of bindings. Regularly spaced sinew bindings at seven places are found on one bow. Another has split *Yucca baccata* bindings in two places. The fourth bow has sinew binding near the end. It seems that a complete bow would have had these regularly spaced bindings along its entire length, probably to facilitate a non-slip grip. There are notches in the ends for securing the bowstrings on four specimens. Three have notches in their sides, about 15 mm from the end, and one has a transverse groove across the flat face. Three bows retain a portion of the bowstring; in two cases, the string is split *Yucca angustissima* leaf and *Yucca baccata* fiber (2-ply S-spun Z-twist 2-reply Z-twist). The bow strings are tied into the bow with square and granny knots. One bow is decorated with wide, green

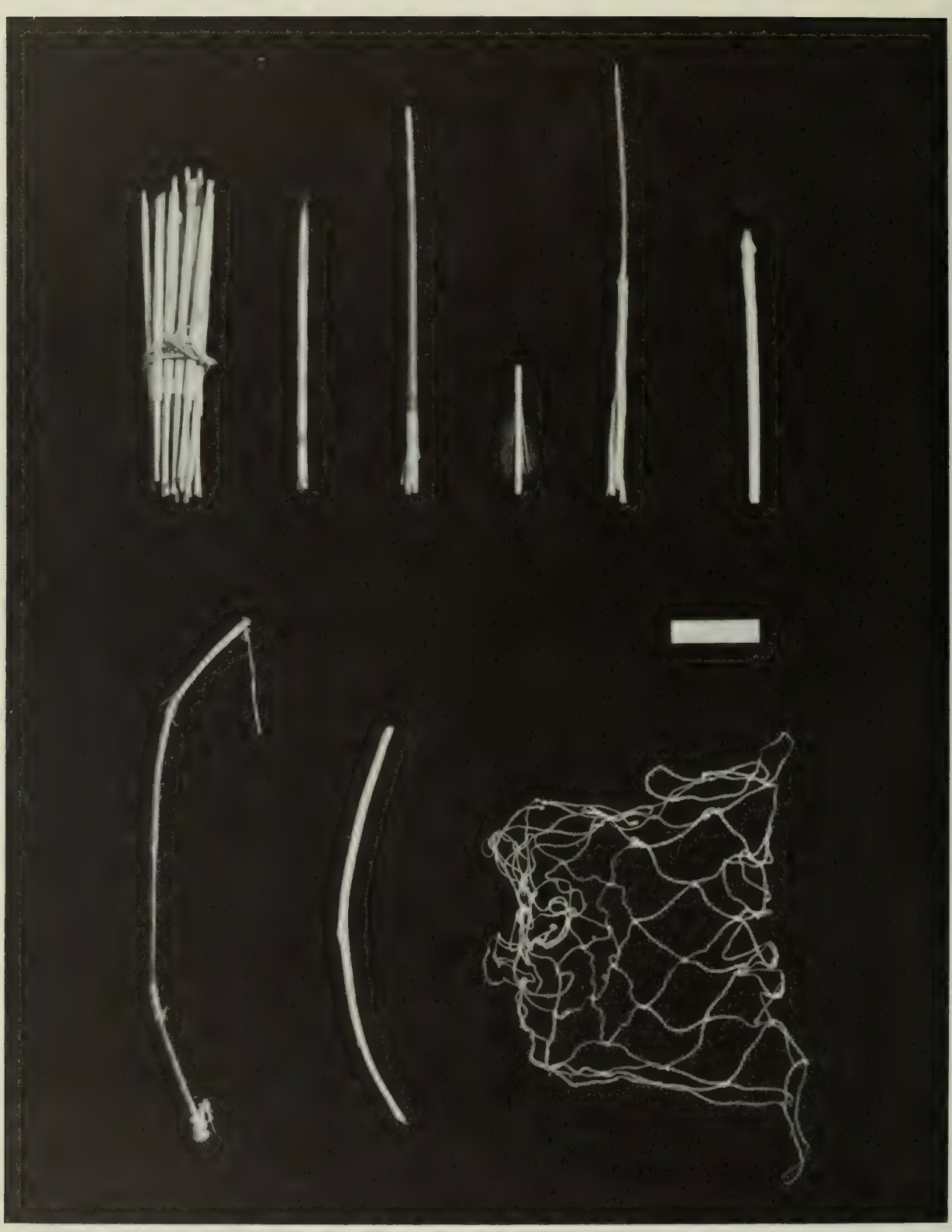


Figure 104. Hunting equipment from Antelope House: (clockwise from top left) bundle of Cercocarpus sp. arrow points, Phragmites communis arrow shaft, P. communis arrow, P. communis arrow shaft nock, Sarcobatus vermiculatus and Senecio sp. arrow, Phragmites communis arrow shaft with lithic point, Yucca sp. net, Quercus gambelii bow fragment and Salix sp. bow.



Figure 105. Hoe (left) and digging sticks of Quercus gambelii from Antelope House.

painted bands. Materials used in making bows are *Quercus gambelii* (4), *Salix* sp. (2), *Pseudotsuga menzeisii* (2), *Acer negundo* (2), *Populus* sp, (2), *Populus angustifolia* (1), *Populus wislizenii* (1) and *Cercocarpus* sp. (1).

There are 232 fragments of compound arrows. In 39 instances, arrow components are found assembled, but in no case is the arrow unbroken. There are 116 separate mainshafts (two of which are complete) and 77 separate points (28 of which are complete). The arrow points are slender shafts, which taper to a blunt or flattened point and which usually have a shoulder and a tang at the base. Tips taper to a blunt point in 39 cases, a flat point in 29 cases and are broken off on the rest. Of the blunt and flat points, 31 percent are splintered and 6 percent are battered. Tangs are present on 77 points and show evidence of having been present on 13 points. Tangs range in length from 1.7 cm to 11.6 cm (mean = 5.1 cm). Pitch for securing the point on the mainshaft has been daubed on 24 of the tangs. Complete points vary in length from 14.2 cm to 27.7 cm (mean = 21.7 cm). The variation in diameter on all points is from 0.6 cm to 1.0 cm (mean = 0.8 cm). Materials used in arrow points include *Sarcobatus vermiculatus* (34), *Cercocarpus* sp. (23), *Fendlera rupicola* (18), *Salix* sp. (13), unidentified non-coniferous species (10), Salicaceae (5), *Amelanchier utahensis* (4), *Acer negundo* (3), *Rhus trilobata* (2), *Philadelphus microphyllus* (1), *Cleome jerrulata* (1), *Quercus gambelii* (1) and *Populus* sp. (1).

There are 19 unfinished arrow points. One is merely an unpeeled cut stick with the tang and shoulder carved. Eighteen roughly cut, unsmoothed flat-tipped points and one mainshaft were found tied together in a bundle with yucca fiber cord. There is also one arrow which exhibits crude resharpening on the tip.

Anderson (1969: 77) suggests that flat-tipped points may have been foreshafts hafted with stone points, but there are no indications of such hafting on any of the specimens from Antelope House, and the temporal distribution of stone points differs from that of wooden points (see Chapter 27). Only one possible hafted lithic point was found; it was hafted not onto a wooden point, but onto an unpeeled 10 cm-long twig of *Salix* sp., split at the tip for insertion of the crude lithic point and bound with split yucca leaf.

The mainshafts are all *Phragmites communis* stems. The two complete shafts are 23.3 cm and 24.6 cm long. Fifteen broken shafts, however, are between 25 cm and 52 cm long, indicating the presence of longer arrowshafts. Shaft diameters vary from 0.4 cm to 1.1 cm (mean = 0.7 cm). There are 55 complete nock ends, 76 percent of which have the ends plugged with a piece of soft wood to reinforce the wedge-shaped notch cut for placement against the bow string. Only

in two cases has the wooden insert been identified; one is *Salix* sp. and the other *Acer negundo*. A short segment of *Phragmites communis*, with a diameter smaller than that of the shaft, has been inserted into the end for reinforcement on 5 percent of the nocks. A straight-cut end, lacking a notch, characterizes another 5 percent of the shafts. The nock end generally has three feathers bound to it with sinew. The feathers have been identified by McKusick (Chaper 12). The shaft end hafted to the point has a binding of yucca (91 percent) or sinew (8 percent). The yucca binding is normally split leaf, but two shafts have yucca fiber binding. There is also one instance each of bark strip binding and cotton cord binding.

There is some type of decoration on 30 percent of the shafts. The most common motif (83 percent) is painted bands. Other decorative motifs include bands and stripes (6 percent), stripes (2 percent), parallel striations (5 percent), and indeterminate painted motifs, probably bands (4 percent). Ten specimens have colored sinew bindings and shafts. Pigments used in painted arrow shafts are 63 percent red, 28 percent black, 12 percent green, 4 percent magenta and 4 percent white. Combinations include red and black (10 cases), red, black and green (4), red and green (4), green and black (1) and red, green and white (1).

There are two yucca nets. One is made of 2-ply S-spun Z-twist *Yucca baccata* fiber. It is knotted with sheep bends and granny knots to form a mesh 5 cm wide. The net measures 55.2 cm by 37.0 cm. The second net is of split *Yuccca baccata* leaves tied in overhand and square knots, forming a mesh 4 cm wide. The net measures 29.0 cm by 15.0 cm.

There are three wooden artifacts which may be throwing sticks, although identification is uncertain. One is a crescent-shaped branch of *Cercocarpus* sp., with one face smoothed and flat and the other irregular. The cross section is rectangular and the ends are irregular in shape. The stick measures 9.0 cm (L) × 2.7 cm (W) × 1.1 cm (Th). A second possible throwing stick is a smoke-blackened branch of *Acer neundo*, measuring 33.0 cm (L) × 3.7 cm (W) × 1.9 cm (Th). The cross section is plano-convex, the faces are smoothed and one end is round, the other diagonal. This artifact might be a batten. The third possibility is a slightly curved *Juniperus* sp. branch with a plano-convex cross section and rounded ends. The ends are charred and one shows use as a pounding implement. One long edge shows use-smoothing. One end narrows asymmetrically to a handle-like projection. The stick measures 34.2 cm (L) × 4.7 cm (W) × 3.8 cm (Th).

Agricultural and/or plant gathering tools recovered from PI to Late PIII proveniences at Antelope House include digging sticks and hoes (Table 128). There is no way of determining whether a digging stick was used as a cultivating tool or a gathering tool, but the hoes probably were confined to agricultural endeavors. Of the 22 digging sticks, nine are complete and range in length from 49.0 cm to 130.0 cm (mean = 84.1 cm). Diameters vary from 1.0 cm to 5.5 cm (mean = 2.2 cm). Digging sticks are straight branches, peeled and smoothed, with a round or oval cross section. The tip is tapered to a blunt point on eight specimens, bifacially beveled to a wedge-shaped point on five specimens and slightly flared on four specimens. The tips are use-polished, as well as chipped and splintered in eight cases, striated and abraded in three cases and fire-hardened in two cases. The handle is use-polished and stained and, on six artifacts, ends in a knob. Digging sticks are made of *Sarcobatus vermiculatus* (6), *Cercocarpus* sp. (5), *Quercus gambelii* (4), *Populus wislizenii* (2), *Salix* sp. (1), *Acer negundo* (1), *Philadelphus microphyllus* (1), *Rhus trilobata* (1) and *Juniperus* sp. (1).

Hoes are similar to digging sticks, but the use end flares out to form a wide, thin blade, rather than tapering to a narrow point. There are two complete hoes. One is a peeled, smooth branch of *Quercus gambelii* with a basal knob and a tip which flares into a flat blade with a diagonal edge. The blade is polished and chipped and the base is use-stained. The hoe is 1.25 m long and the blade is 7.0 cm wide by 2.6 cm thick. The second hoe is highly curved at the blade end, rather like a sicle. It is a polished shaft of *Quercus gambelii*, measuring 1.12 m long and possessing a basal knob. The shaft flares into a blade 6.5 cm wide and about 0.5 cm thick. The blade is bifacially beveled, has striations on the convex edge and is chipped on the concave edge.

The modified vegetal material recovered from Antelope House trash deposits yielded 1.075 kg of knotted corn husks. These knotted husks seem to represent a method of storing corn ears by knotting husks together.

Domestic and Craft Tools

One complete PIII cradle and portions of four others were found at Antelope House. Three cradles, including the complete specimen, are of the bent wood type and one is a split board cradle. There are two isolated cradle hoods. Figure 77 shows three bent wood cradles; the center cradle was found as part of the child burial discussed above. The bent wood cradles are of *Quercus* sp. (2 cases) and *Salix exigua* (1 case). These cradles consist of a flexible branch bent into an elongated loop, with some kind of woven backing stretched between the two longest edges of the loop. The woven backing of the first cradle consists of *Phragmites communis* matting twined with yucca cord and includes a *Zea mays* husk padding at its foot. The second cradle has a transverse wrapping of *Scirpus americanus* secured by twining near the frame with *Yucca baccata* cord. A feather and fur-wrapped yucca cord lacing probably held the child firmly in the cradle. The third cradle has a backing of vertical *Phragmites communis* matting twined with yucca cord. This vertical matting is overlaid with a piece of horizontal *Phragmites* matting twined with human hair cord. The frame is wrapped with 2/2 rhythm plaited matting of *Salix exigua* bark. The bent wood cradles vary in size from 43.7 cm by 23.5 cm to 90.0 cm by 32.0 cm. The three hoods are of *Populus tremuloides* bent into a curved shape to fit the curvature of the frame. Plain weave cotton cloth fragments were attached to the hoods at the place where they would have come into contact with the child's neck.

The back, sides and foot of the split board cradle are formed on 10 slats. The slats are of Salicaceae and formerly were attached to one another by means of sinew ties inserted through holes drilled in the slats. In addition to this relatively complete, although unassembled, split board cradle, there are other cut slats, which may have formed part of a cradle at one time.

Fire-making equipment consists of a hardwood drill and a soft hearth. Hearths are pieces of soft wood with oval or plano-convex cross sections. There is a single row of from one to six holes drilled into one side, the flat side in the case of the plano-convex specimens. The thinnest wall of the drilled hole is cut away, producing a side notch. There are 30 fire hearth fragments from Antelope House, ranging in length from 2.8 cm to 21.1 cm (mean = 7.0 cm) and in diameter from 0.7 cm to 2.1 cm (mean = 0.9 cm). Materials used in fire hearths are *Populus wislizenii* (11), *Populus* sp. (8), *Acer negundo* (6), *Zea mays* stem (2), *Salix* sp. (1), Salicaceae (1) and unidentified wood species (1).

Fire drills are shafts which fit into the drilled holes in fire hearths. There are eight of these, one of which is complete and one of which is hafted. The working tip is rounded and the shaft is straight and peeled in all but two cases. The tip is fire-blackened and use-polished. The hafted specimen is hafted by means of an overlapping rabbit joint, secured with a yucca leaf tie. The complete drill is 25.8 cm long and the broken ones range from 7.0 cm to 41.4 cm in length. Diameters range from 0.7 cm to 1.2 cm (mean = 1.0 cm). Materials used include *Populus wislizenii* (3), *Populus* sp. (2), *Acer negundo* (2) and *Salix* sp. (1). The haft is *Helianthus* sp.

A *Yucca angustissima* caudex, a complete *Yucca angustisima* plant and a *Zea mays* shank show burining on one end, which may indicate their use as torches.

The 45 pot rests from Antelope House are rings of many different materials, usually bound with a tie or wrapping (see Fig. 106). Pot rests range in diameter from 10.0 cm to 23.8 cm (mean = 15.2 cm). Materials used in pot rests include *Zea mays* (7, including 2 wrapped with *Yucca angustissima* ties), *Salix exigua* twigs (5), *Salix* sp. wrapped with *Zea mays* husks (1), *Salix amygdaloides* twigs (1), *Muhlenbergia racimosa* (5, including 1 wrapped with feather-wrapped *Yucca angustissima* fiber cordage, 1 with *Yucca baccata* feather cord and 1 with *Yucca baccata* ties), *Juniperus* sp. bark (3, including 1 wrapped with *Yucca angustissima* cordage), *Yucca baccata* (2), *Yucca angustissima* (2), *Yucca* sp. cord wrapped with feather-wrapped *Yucca* sp. cord (1), Graminea (2, including 1 wrapped with a strip of plainweave cotton textile), *Phragmites communis* wrapped with *Salix* sp. bark strips (1), *Sporabolus crytandrus* wrapped with *Yucca baccata* ties (1), *Agnostis exerata* (1), *Eragrostis diffusa* (1), *Glyceria striata* wrapped with *Salix* sp. bark (1), *Scirpus americanus* (1), *Artemisia tridentata* (1), *Muhlenbergia racimosa, Glyceria striata, Agropyron trachycaulum* and *Populus* sp. wrapped with *Yucca angustissima* fiber cord (1), and *Sporabolus cryptandrus* and *Juniperus* sp. bark wrapped with *Yucca baccata* fiber cord and leaf ties (1).

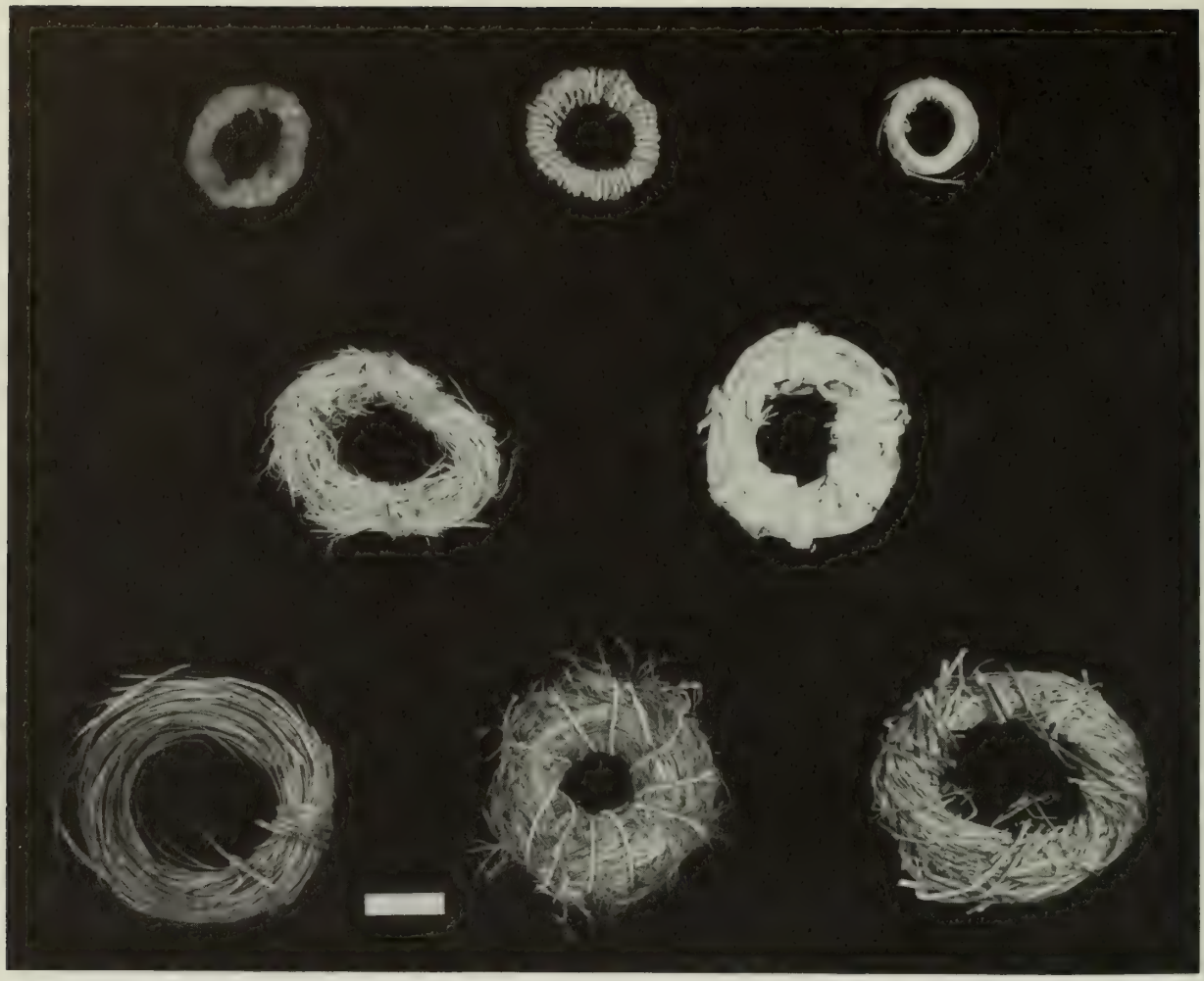


Figure 106. Pot rests from Antelope House. Materials used are (from top left) Yucca sp., Populus sp. Graminea, Sporabolus cryptandurs, Zea mays, Rhus trilobata, Juniperus sp. and Salix sp.

There are two possible rack supports, which could have been used for suspending crops for storage, meats for drying or cooking pots over the fire. The rack supports are forked branches of *Populus* sp. and *Fendlera rupicola*. Their dimensions are 15.4 cm × 2.3 cm (width across the fork) × 0.4 cm (diameter of shaft) and 10.0 cm × 2.5 × 0.8 cm. The *Fendlera* specimen is bound with sinew, which secures a remnant of human hair cord.

Two spoon-like chips of *Populus* sp. and *Quercus gambelii* may have been used as scoops. The *Populus* scoop is complete and measures 19.4 cm long, 8.9 cm wide and 0.7 cm thick. The ends show use stain and bifacial abrasions. The broken scoop is 3.5 cm wide and 0.4 cm thick at the spatulate end. The opposite end is a broken handle (0.2 cm wide), which has been perforated in two places near the spoon and strung with S-twisted sinew.

There is one small fork; it is made of a slender twig of unidentified wood and has been peeled and smoothed. It tapers to two prongs, each 11 mm long. The base is slightly rounded. The shaft has transverse striations along its length. The fork is 2.0 cm long and 0.9 cm wide. One identifiable stirring stick consists of a broken *Sarcobatus vermiculatus* shaft (0.6 cm in diameter), with a tip flattened into a blade and exhibiting abrasive smoothing. The tip is covered with a substance resembling corn mush.

Paddles are spatulate branches with abraded

ends, which could have been used in scraping or stirring (cf. Anderson 1969: 106). There are nine paddles, two of which are complete. The angle and placement of the abrading indicate that the paddles were scraped against a surface in a perpendicular manner. The worked end is rounded, often diagonal. One paddle is a reused batten. Two complete paddles are 16.1 cm and 26.5 cm long. The incomplete specimens range from 7.4 cm to 23.0 cm long. Width varies from 0.9 cm to 2.0 cm (mean = 1.3 cm). Materials used for making paddles are *Populus wislizenii* (3), *Populus* sp. (2), *Juniperus* sp. (1), *Cercocarpus montana* (1), *Pseudotsuga menziesii* (1) and one keratogenous (horn).

Forty-one wooden splinters, showing use abrasion on one end, have been identified as scrapers. These taper to a spatulate use end in 59 percent of the specimens; the spatulate end is diagonal in 42 percent of these cases. Half of the scrapers show bifacial abrasion. Two scrapers are stained with red pigment. Three scrapers show perpendicular use, similar to that event on the paddles, and one scraper seems to have been abraded unifacially one one end, perpendicularly on the other. One highly polished and use-stained specimen has a series of 13 shallow, partially bifacial grooves, suggesting that it at one time was intended to be a weaving comb.

The other 17 scrapers have less pronounced spatulate use ends. Fifty-three percent are diagonal and 12 percent are bifacial. Seven show perpendicular use and three are used on both ends. The cross sections are oval (7), plano-convex (6), rectangular (4) or concave-convex (1). Those used perpendicularly have diagonal and flat ends.

Eighteen of the scrapers are complete, ranging in length from 7.5 cm to 45.7 cm (mean = 14.2 cm). All scrapers vary in width from 0.7 cm to 6.2 cm (mean = 1.5 cm) and in thickness from 0.2 cm to 1.6 cm (mean = 0.6 cm). Scrapes are made of *Pseudotsuga menziesii* (10), *Juniperus* sp. (9), Salicaceae (6), *Populus* sp. (5), *Salix* sp. (4), *Acer negundo* (1), *Pinus ponderosa* (1), *Pinus* sp. (1), *Sarcobatus vermiculatus* (1), *Fendlera rupicola* (1), *Rhus trilobata* (1) and *Helianthus* sp. (1).

Sixteen awls from Early to Late PIII proveniences have been identified, 12 of which are complete. They are short, pointed sticks with round or slightly plano-convex cross sections. The tips are pointed and polished. The flattened cross sections were created by removing a splinter from one face. The bases on the complete specimens are flat. One awl appears to have been resharpened. Six awls are found bound together with *Yucca angustissima* and *Zea mays* husk ties. The complete awls range in length from 6.3 cm to 25.6 cm (mean = 13.2 cm). Diameters range from 0.6 cm to 1.5 cm (mean = 0.9 cm). Materials used in awls are *Fendlera rupicola* (2), *Sarcobatus vermiculatus* (1), *Acer negundo* (1), *Populus wislizenii* (1), *Rhus trilobata* (1) and unidentified species (7).

The different uses of wooden and bone awls are unknown. Anderson's (1969: 75) informants generally suggested their use in packing the wefts and separating warp threads in weaving. If they were strong enough, the wooden awls could have been used in basket manufacture and in hide-working.

There is one complete punch. It is a crudely cut, unsmoothed twig of *Cleome serrulata*, measuring 15.3 cm long and 1.0 cm in diameter. The base is flat and the tip resembles a graver point.

Three types of handles were found at Antelope House: bent twig, shaft and tabular. The seven bent twig handles are of *Salix* sp. (3), *Quercus gambelii* (3) and unidentified wood species (1). They were made by looping a supple branch around an axe or maul. In two cases, the axe is still in place (Fig. 107). A wrapping of *Yucca baccata* ties, yucca cord, human hair cord or split *Rhus trilobata* was used to secure the branches. The lengths of the two complete bent twig handles are 36.0 cm and 53.5 cm. The diameter of the branches varies from 1.5 cm to 2.5 cm.

The seven shaft handles are slender twigs slit on one end for the hafting of a lithic. Four handles retain the lithic: one graver, one burin, one point and one indeterminate lithic (see Fig. 108). The twigs are of *Phragmites communis* (2), *Salix* sp. (2), *Populus* sp. (1), *Rhus trilobata* (1) and unidentified wood (1). Only one handle is complete; its length is 16.5 cm. The broken handles range from 5.0 cm to 33.5 cm long. Diameters vary from 0.4 cm to 1.5 cm (mean = 1.7 cm). Yucca cord or split leaf ties bind the lithics to the handles.

The single tabular handle is a smoothed tablet of Salicaceae, with the tip grooved for hafting. The base tapers and has an encircling transverse groove bound with sinew. A hole is drilled through the base. The handle is 10.8 cm long, 2.2 cm wide and 1.0 cm thick. Similar handles

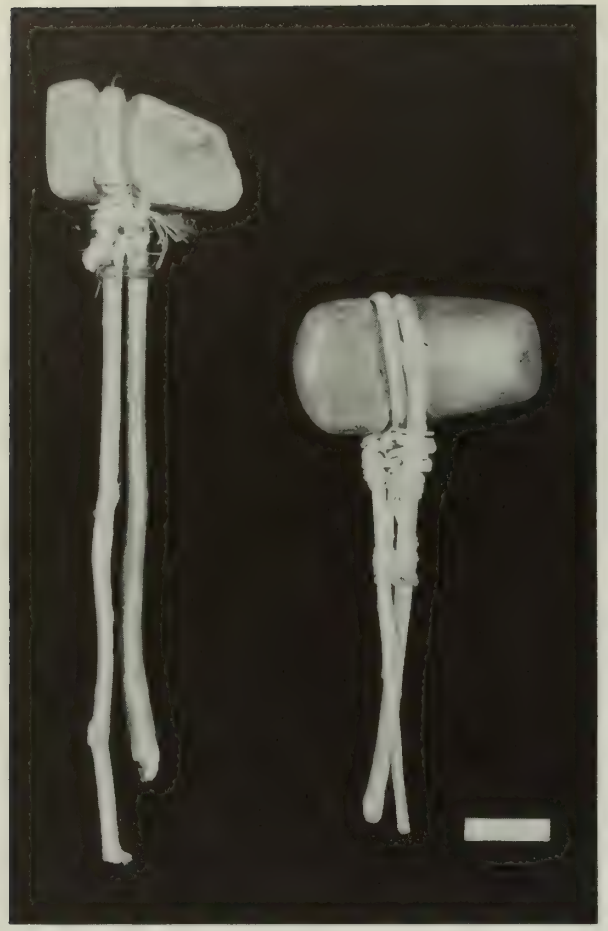


Figure 107. Stone axes, hafted with Quercus gambelii, from Antelope House.

with knife or scraper blades are reported by Anderson (1969: 78).

Nineteen diverse materials bear globs of pitch, suggesting their use as pitch applicators. The most common is a folded *Yucca baccata* leaf (5). A similar artifact is a folded strip of *Rhus trilobata* bark. Three *Yucca baccata* fiber bundles and a feather quill also qualify as pitch applicators. Two splinters of an unidentified coniferous species and seven twigs complete the inventory. The twigs have been identified as *Quercus turbinella, Populus* sp., *Fendlera rupicola, Sarcobatus vermiculatus, Acer negundo* and *Cercocarpus* sp.

There are eight brushes formed by shredding *Yucca baccata* (3), *Yucca angustissima* (2), *Atriplex canescens* (2) and *Salix* sp. (1). The brushes of *Atriplex* are shredded on both ends, with lengths of 12.0 cm and 9.7 cm and diameters of 2.3 cm and 1.8 cm. Both are stained with a magenta pigment. One *Yucca baccata* brush is a single leaf, partially shredded on one end. The other yucca brushes are bundles of leaves, which in all but one case have been bound with yucca. One has a single tie of yucca and two have bindings which cover all but 2 cm to 5 cm at both ends. The yucca bundle brushes range in length from 11.5 cm to 25.5 cm. The *Salix* sp. brush is a strip of bark measuring 6.5 cm by 3.0 cm. It has been shredded along one short edge. Brushes are shown in Figure 109.

Table 129. Edible and medicinal bundles.

Species	*Plant Part*	*Construction*	*No. of cases*
Eriogonum simpsonii	twigs	bound with *Yucca baccata*	1
	twigs	mixed with *Juniperus scopulorum* and bound with *Yucca* sp. cord	1
	roots	bound with *Yucca baccata*	1
Rumex humenosepolus	roots	bound with *Yucca* sp. cord	2
Datura meteloides	twigs	bound with *Yucca baccata*	2
Atriplex jonesii	twigs	chain strung with *Yucca baccata*	2
Populus wislizenii	leaves	folded	2
Aster foliaceus	leaves	chain strung with *Yucca baccata*	1
Pectis angustifolia	twigs	bound with *Yucca angustissima*	1
Poliomintha incana	twigs	bound with *Yucca angustissima*	1
Tetradymia canescens	twigs	bound with *Yucca baccata*	1

Dimensions
Length: range 5.0 to 29.5 cm
Width: range 1.3 to 14.0 cm



Figure 108. Hafted lithics from Antelope House: (from left) Salix sp. shaft on drill, Phragmites communis shaft on drill and P. communis shaft on graver.



Figure 109. Brushes from Antelope Hose. Materials used are (from left) Salix sp., Yucca baccata, Atriplex canescens and two examples of Yucca angustissima.

Bundles and Pads

There are 355 bundles of diverse form, size and material. Some are made of vegetal materials used historically as food, condiments or medicine. Some appear to be raw materials stored for such activities as basket making, arrow manufacture and roof construction. Some are ring-shaped and could be pot rests, although they exhibit no evidence (i.e., soot or flattening) of serving such a function. Other bundles served unknown purposes. The most common bundle type (57 percent) consists of a number of twigs or stems and is bound with some kind of tie. The second most common bundle (26 percent) is the ring. Another 6 percent are coils and 5 percent are groups of bundles chain-linked together. Four percent are knotted; 1 percent are folded, and 1 percent are matted.

Table 130. Raw material bundles.

Species	*Plant Part*	*Construction*	*No. of Cases*	*Dimensions*
Rhus trilobata	twigs	coil	3	Dia.
	twigs	ring bound with *Yucca baccata*	2	4.0–23.0 cm
	twigs	ring bound with *Rhus*	3	
	twigs	bound with *Rhus*	28	L 6.1–52.2 cm
	twigs	bound with *Yucca baccata*	2	
	twigs	bound with *Yucca* sp. cord	1	W 0.3–10.0 cm
Salix sp.	twigs	coil	6	Dia.
	twigs	ring	3	4.0–26.0 cm
	twigs	ring bound with *Zea mays* and *Yucca* sp.	1	
Salix exigua	twigs	ring	8	
	twigs	bound with *Yucca* sp. cord	1	
Salix sp.	twigs	bound with *Salix* sp.	1	
	twigs	bound with *Yucca baccata*	1	
	twigs	bound with *Yucca baccata* and *Zea mays* husk	1	
	twigs	bound with bark	1	L 7.0–50.7 cm
	twigs	bound with *Zea mays* husk	1	
	twigs	with unidentified wood, binding of *Yucca baccata*	1	
	twigs	with *Populus* sp., binding of *Yucca angustissima*	1	W 0.9–8.5 cm
	twigs	with *Juniperus osteosperma*, binding of *Apocynum* sp. cord	1	
Salix amygdaloides	twigs	bound with same	1	
Populus sp.	twigs	ring	1	Dia.
	twigs	ring bound with same	1	5.5–7.4 cm
	twigs	ring bound with *Populus* sp. bark	1	
	twigs	bound with same	2	
	twigs	bound with *Yucca angustissima* cord	1	
	twigs	with *Yucca angustissima*, binding of *Salix* sp.	1	L 11.9–39.0 cm
	twigs	with *Zea* husk, binding of *Yucca baccata*	1	W 0.9–9.0 cm
	twigs	with *Sporabolus cryptandrus*, binding of *Yucca baccata*	1	
Juniperus sp.	twigs	bound with *Yucca angustissima* cord	2	L 8.5–28.8 cm
	splints	bound with *Yucca baccata* cord	1	
Juniperus osteosperma	twigs	bound with *Yucca baccata* cord	1	W 0.5–3.6 cm
Quercus gambelii	twigs	ring	1	Dia. 14.4 cm
	twigs	bound with same	3	L 12.6–27.5 cm
	twigs	bound with *Yucca baccata*	2	W 1.6–13.0 cm
Phragmites communis	stems	bound with *Yucca baccata*	5	
	stems	bound with *Yucca baccata* cord	1	
	stems	bound with *Yucca angustissima* cord		L 0.5–64.0 cm
	stems	bound with *Zea mays* husk		
	stems	bound with sinew		W 0.7–9.3 cm
	stems	bound with *Juniperus* sp. bark	1	
	stems	bound with *Populus* sp. bark	1	
Scirpus americanus or *Typha latifolia*	stems	ring bound with same	1	Dia. 12.5 cm
	stems	bound with same	1	L 5.8–39.5 cm
	stems	bound with *Yucca angustissima*	1	W 0.6–5.2 cm
Fendlera rupicola	twigs	bound with sinew	1	15.0 × 0.9 cm

Table 131. *Zea mays* bundles.

Plant Part	*Form*	*Construction*	*No. of Cases*	*Dimensions*
cobs	chain	strung on *Yucca angustissima* cord	1	
	chain	strung on *Yucca baccata* cord	2	L 4.9–39.0 cm
shanks	chain	strung on *Yucca angustissima*	9	
	chain	strung on *Yucca baccata*	1	W 2.0–9.8 cm
	chain	strung on *Salix* sp. bark	1	
	chain	strung on bark	1	
husks	ring		29	
	ring	binding of husks	1	Dia.
	ring	binding of *Yucca baccata*	1	1.9–7.0 cm
	ring	binding of *Yucca angustissima*	1	
	coil		1	
	bound	binding of husk	11	
	bound	binding of *Yucca angustissima*	3	
	bound	binding of *Yucca baccata* cord	1	
	bound	binding of *Yucca angustissima* cord	1	
	bound	binding of *Yucca baccata* cord and sinew		L 3.6–22.8 cm
	bound	binding of *Yucca angustissima* and cotton cord	1	
	folded		1	
cobs	bound	binding of husks	3	
	bound	binding of *Yucca baccata*	1	W 0.9–10.0 cm
	bound	binding of *Yucca baccata* and *Salix* sp. bark	1	
	bound	wrapped with *Cucurbita* rind and *Yucca angustissima*	1	
tassels	bound	binding of husks	4	

The 15 bundles formed of edible or medicinal materials include three of *Eriogonum simpsonii* (Whiting 1939: 73), two of *Rumex humenosepolus* (Stevenson 1915: 98), two of *Datura meteloides* (Whiting 1939: 89), two of *Atriplex jonesii* (Jones 1931: 24), two of *Populus wislizenii* (Curtin 1947: 19), one of *Aster foliaceus* (Whiting 1939: 194), one of *Pectis angustifolia* (Whiting 1939: 97), one of *Poliomintha incana* (Whiting 1939: 91) and one of *Tetradymia canescens* (Whiting 1939: 98). Details of these bundles are summarized in Table 129 and Figure 110 illustrates several.

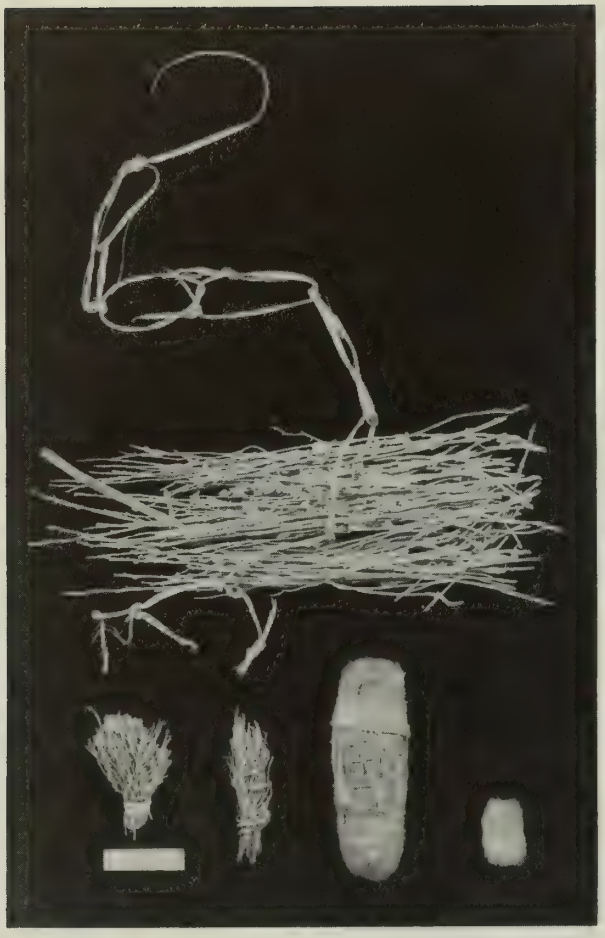
There are 101 bundles of raw materials (see Fig. 111 and Table 130). These bundles are of *Rhus trilobata* (39), *Salix* sp. (19), *Phragmites communis* (1), *Salix exigua* (1), *Salix amygdaloides* (1), *Populus* sp. (9), *Quercus gambelii* (6), *Juniperus* sp. (3), *Juniperus osteosperma* (1) and *Scirpus americanus* or *Typha latifolia*.

There are 83 *Zea mays* bundles, utilizing tassels, husks and cobs (see Table 131 and Fig. 112). A unique specimen consists of a folded husk, forming a bag closed at the mouth by a binding of *Yucca baccata* cord. Inside the husk bag were balls of an unidentified resin. The bag measures 13.5 cm long, 5.8 cm wide and 1.7 cm thick.

There are 96 bundles of *Yucca baccata* and *Y. angustissima* (Table 132). The 31 rings and coils range in diameter from 1.7 cm to 37.0 cm (mean = 3.8 cm). The other bundles range in length from 3.0 cm to 65.0 cm (mean = 17.5 cm) and in width from 0.5 cm to 13.0 cm (mean = 4.2 cm).

There are 55 bundles with no clear function (see Table 133 and Fig. 113). These bundles are of *Juniperus* sp. (11), *Populus* sp. (7), *Populus tremuloides* (1), *Populus wislizenii* (1), *Artemisia tridentata* (3), *Artemisia ludoviciana* (1), *Artemisia bigelovii* (1), *Rhus trilobata* (3), *Phragmites communis* (3), Graminae (3), *Salix* sp. (2), *Salix amygdaloides* (1), *Apocynum* sp. (1), *Philadelphus microphyllus* (1), *Helianthus* sp. (1), *Lesqueralla intermedia* (1), mixed grasses and shrubs (2), unidentified wood species (6), unidentified bark (3), unidentified roots (2), and unidentified fiber (1).

There are eight pads of matted vegetal material, showing compaction and abrasion. They range in length from 7.5 cm to 22.0 cm, in width



from 5.0 cm to 18.0 cm and in thickness from 0.5 cm to 6.3 cm. The materials have been identified as *Artemisia ludoviciana* (2), *Artemisia* sp. (2), *Cercocarpus* sp. (1) and Caprifoliaceae (1). Two are unidentified. The *Artemisia* sp. may have been intended as fill for cigarettes (Hough 1931:36).

Miscellaneous Artifacts

Wooden rings have several ethnographically documented uses. Looped twigs served as the framework for snowshoes (Morris 1919: 57) and two Antelope House rings appear to have served this purpose. These consist of an oval loop crossed by lacing, the central portion of which is covered by a padding for the foot. One of the snowshoes consists of a *Quercus gambelii* loop with a netting of *Yucca baccata* leaves secured by overhand knots. A pad of twigs and leaves is in

Figure 110 (left). Medicinal and ceremonial bundles from Antelope House. Materials used are (top) Atriplex jonesii and (from left) Pectis angustifolia, Erigonium simpsonii, Juniperus sp. and Yucca sp.

Figure 112 (below). Zea mays artifacts from Antelope House (clockwise from left): strung shanks, husk ring, hish "lightning effigy," husk braid, cob bundle, skewered cobs, husk and cob bundle, husk bundle, husk bag with pitch balls, plaited husk and tassel bundle.



the center of the netting. The artifact measures 39.0 cm along the long axis and 24.0 cm along the short axis. The second snowshoe is a hoop of *Rhus trilobata* wrapped with a twined net of 2-ply S-spun Z-twist *Yucca* sp. cord and *Yucca baccata* leaves. It bears a pad of *Zea mays* husks. The artifact is oval, with a diameter of 21.0 cm.

Wooden rings also were used as targets in the hoop and dart game of the pueblos (Culin 1907: 420). Three rings which match Culin's descriptions were found at Antelope House. These consist of intricately netted hoops. One is a *Salix*



Figure 113. Miscellaneous bundles from Antelope House. Materials are (from left) Quercus gambelii, Datura sp., Populus sp. and unidentified herbaceous plant.

Figure 111. Raw material bundles from Antelope House (clockwise from top left): two examples of Rhus trilobata, Yucca angustissima, R. trilobata, Scirpus sp. and two examples of Juniperus sp.

sp. hoop with a net of *Yucca angustissima* secured by square knots. The second is a *Rhus trilobata* hoop with looped netting of 2-ply S-spun Z-twist *Yucca baccata* cord and unidentified fiber. The third is a *Quercus gambelii* hoop with a netting of *Yucca baccata* leaves tied with square and overhand knots. The hoop diameters are 10.7 cm, 16.8 cm and 29.0 cm.

Wooden hoops without netting also are reported as targets in the hoop and dart game (Culin 1907: 420). There are 13 rings from Antelope House which may have been so used. These range in diameter from 14.0 cm to 33.5 cm. They are of *Quercus gambelii* wrapped with same (1), *Quercus gambelii* wrapped with *Yucca baccata* (1), *Quercus turbinella* wrapped with *Yucca angustissima* (1), *Salix* sp. wrapped with *Yucca angustissima* (1), *Salix* sp. wrapped with *Yucca angustissima* and *Salix* sp. bark fiber (1), *Rhus trilobata* bound with same (3), and *Rhus trilobata* bound with *Yucca baccata* (3).

Fifty-eight rods exhibit the unifacial smoke-blackening characteristic of rods used in roof construction. Twelve are complete and range in length from 34.3 cm to 60.9 cm (mean = 46.0 cm) and in diameter from 0.6 cm to 21.4 cm (mean-1.0 cm). Ends generally are flat (84 percent), but 7 percent have beveled ends, and 5 percent have one flat end and one pointed end. Roof rods are of *Salix* sp. (55) and *Populus wislizenii* (3).

There are 107 rods for which no particular

Table 132. Yucca bundles.

Species	*Form*	*Construction*	*No. of Specimens*
Yucca baccata	ring	binding of *Populus* sp. bark	1
	ring	binding of *Y. baccata* cord	1
	ring	binding of same	12
	ring	knotted	1
	ring	twined cord	1
	ring	twined feather cord	1
	coil		7
	folded		1
	bound		20
	bound	binding of *Yucca* sp. cord	1
	bound	twined cord	1
Yucca angustissima	ring	plaited	1
	ring		1
	ring	binding of same	2
	folded		1
	knotted		2
	bound	binding of same	15
	bound	binding of same cord	3
	bound	binding of same and cotton textile	1
	bound	twined cord	1
Yucca baccata and *angustissima*	matted		1
Yucca sp.	ring		1
	ring	fiber, binding of same	1
	knotted	twined cord	1
	bound	binding of bark	1
	bound	roots, binding of *Yucca baccata*	1
	bound	fiber	
	bound	fiber, binding of cotton cord	2
	bound	cord, binding of same	6
	bound	braid, binding of cord	1
	bound	fiber around roots, binding of cord	
	bound	fiber around caudex, binding of leaf	1
	bound	fiber around unidentified wood, binding of cord	1

Table 133. Miscellaneous bundles.

Species	*Plant Part*	*Construction*	*No. of Cases*	*Dimensions*
Populus sp.	twigs	coil	2	
	twigs	ring bound with *Yucca baccata*	2	Dia.
	bark	coil	1	4.7–13.7 cm
	bark	ring	1	
	bark	folded	1	L 4.8–12.8 cm
Populus wislizenii	bark	folded	1	
Populus tremuloides	bark	folded	1	W 1.6–4.0 cm
Juniperus sp.	bark	ring	1	Dia.
	bark	coil	2	4.0–8.7 cm
	bark	matted with *Zea mays* husks and *Yucca baccata* cord	1	
	bark	bound with same	2	L 7.0–32.0 cm
	bark	bound with *Yucca baccata*	4	W 2.5–7.5 cm
	bark	bound with *Yucca angustissima*	1	
Salix sp.	bark	folded	1	Dia. 6.5 cm
	twigs	ring	1	Dia.
Salix amygdaloides	twigs	ring	1	5.8–9.7 cm
Artemisia tridentata	twigs	ring	1	Dia. 6.5 cm
	twigs	bound with *Yucca baccata*	1	
	twigs	bound with *Yucca baccata* and *angustissima*	1	L 10.4–27.8 cm
Artemisia bigelorii	twigs	bound with *Yucca angustissima*	1	W 3.9–8.5 cm
Artemisia ludoviciana	twigs	folded	1	
Rhus trilobata	twigs	ring	3	Dia. 5.6–6.5 cm
Graminae	stems	ring	1	Dia. 7.2 cm
	stems	bound with *Yucca* sp. cord	1	L 4.2–7.0 cm
	roots	mixed with *Yucca* sp. roots, bound with *Yucca* sp. cord	1	W 1.9–3.2 cm
Phragmites communis	leaves	ring bound with *Yucca angustissima*	1	Dia. 13.2 cm
	leaves	bound with same	1	L 4.9–7.0 cm
	leaves	folded	1	W 0.3–1.8 cm
Apocynum sp.	fiber	wrapped around *Phragmites* stems, bound with *Yucca* sp. cord	1	5.0 × 1.7 cm
Lesquerella intermedia	twigs	bound with *Salix* sp. bark	1	9.5 × 3.5 cm
Philadelphus microphyllus	stems	bound with *Zea mays* husk	1	9.5 × 0.8 cm
Helianthus sp.	twigs	bound with *Yucca* sp.	1	4.4 × 0.5 cm
Sporabolus cryptandrus, Amaranthus blitoides, Poa fendleriana, Cycloloma trifolium, Portulaca oleracea, Sphaeralcea, *Zea mays* husks	stems	matted	1	11.0 × 10.0 cm
Muhlenbergia asperfolia, Muhlenbergia racimosa, Amaranthus blitoides	stems	matter	1	10.5 × 8.5 cm
Unidentified wood	twigs	ring	1	Dia. 3.8 cm
	twigs	bound with same	2	
	twigs	bound with *Yucca angustissima*	1	
	twigs	bound with *Yucca* sp.	2	L 3.0–29.0 cm
	roots	bound with *Yucca baccata*	1	
	roots	folded	1	W 1.0–4.0 cm
	bark	folded	2	
	bark	fiber, bound with same	1	
Unidentified fiber	fiber	bound with *Zea mays* husks	1	2.9 × 1.1

function is evident. Forty-four are complete and range in length from 1.5 cm to 69.2 cm. Rod lengths may be divided into three categories: 1.5 cm to 10.2 cm (57 percent), 11.3 cm to 25.6 cm (32 percent) and 34.2 cm to 69.2 cm (11 percent). The broken rods tend to be longer, with 65 percent measuring more than 10 cm in length. Rod diameters range from 0.7 cm to 5.2 cm (mean = 1.5 cm). Rod ends most commonly are flat (45 percent) or rounded (35 percent), but nine specimens have unsmoothed grooved and snapped ends, five have one conical end, two are flared on the ends, and one has a flattened point with two facets. Most rods are peeled, but six are unpeeled and five are partially peeled. Two distinctive rods were recovered from kiva proveniences. These have chert or quartzite nodules embedded in one end, and it is tempting to suggest for them a ceremonial function.

Materials used for making rods are *Salix* sp. (25), *Salix laevigata* (1), *Populus wislizenii* (20), *Populus* sp. (13), *Acer negundo* (15), *Quercus gambelii* (8), *Amelanchier utahensis* (7), *Cercocarpus* sp. (4), *Juniperus* sp. (3), *Alnus oblongifolia* (2), *Fendlera rupicola* (2), *Sarcobatus vermiculatus* (2), and *Betula occidentalus* (1).

Twelve other rods are uniformly curved in a shallow arc. All but one are complete. The rods vary in length from 17.6 cm to 23.4 cm (mean = 20.1 cm). Diameters range from 0.4 cm to 0.9 cm (mean = 0.6 cm). Ends taper to a blunt point on 10 specimens. Two curved rods have beveled ends and two have blunt points on both ends. Ten rods are unpeeled and two are partially peeled. Two of the rods are bound together medially with yucca cord. Four curved rods have designs on their concave faces; two have incised X's, one has a red pigment stain and one has incised X's and black bands. The uniformity of these rods suggests they were made for some specific purpose. Curved rods are made of *Fendlera rupicola* (7), *Cercocarpus* sp. (2), *Populus* sp. (1), *Amelanchier utahensis* (1) and unidentified wood species (1).

Another 14 rods are bisected. Six of these are complete and range in length from 5.2 cm to 19.0 cm (mean = 11.0 cm). Two broken rods are 36.5 cm and 46.0 cm long. Diameters vary from 0.7 cm to 4.3 cm (mean = 1.9 cm). Ends vary from round to flat. Six bisected rods have grooves down the pith on the flat face. Four rods are decorated; two have black painted parallel transverse lines on the flat face and two have black painted motifs on the convex face. One of the latter has parallel lines and the other has bands. Decorated rods are between 5.2 cm and 9.2 cm in length and may be dice. Bisected rods are made of *Salix* sp. (6), *Acer negundo* (2), *Populus* sp. (1), *Populus wislizenii* (1), *Populus acuminata* (1), *Quercus gambelii* (1), *Pseudotsuga menziesii* (1), Salicaceae (1), and unidentified wood (1).

A unique specimen is a hafted bisected rod of *Acer negundo*. The rod is bound with *Yucca angustissima* ties to a *Sarcobatus vermiculatus* twig. The complete artifact is 39.8 cm long.

There are five perforated rods, ranging in length from 2.9 cm to 11.8 cm (mean = 5.8 cm) and in diameter from 1.0 cm to 3.4 cm (mean = 1.8 cm). Four are of *Acer negundo* and one is of *Populus* sp. The ends are flat (2), round (1), conical (1) and pointed with two flat facets (1). Two are completely perforated and could be beads; one of these is decorated with transverse black bands. Two are partially perforated at both ends and one is partially perforated at one end.

There are 125 wooden shafts to which no function can be assigned. All but three are broken. The fragments could be spindle shafts, arrow points, finishing needles, shed rods, handles, fire drills or any other artifact with a shaft. The shafts with one unbroken end are 32 percent flat and 25 percent round. Shaft lengths range from 4.0 cm to 63.0 cm (mean = 17.5 cm). The three complete shafts are 17.5 cm, 18.9 cm and 31.0 cm long. Diameters vary from 0.3 cm to 1.1 cm (mean = 0.5 cm). Identified materials include *Sarcobatus vermiculatus* (66), *Philadelphus microphyllus* (13), *Salix* sp. (12), *Acer negundo* (9), *Cercocarpus* sp. (8), *Phragmites communis* (3), *Fendlera rupicola* (8), *Populus* sp. (2), Salicaceae (2), *Quercus* sp. (1), *Quercus turbinella* (1), *Amelanchier utahensis* (1) and *Senecio* sp. (1).

There are 22 pointed sticks. Four are complete and range in length from 9.3 cm to 12.7 cm; the incomplete sticks vary from 6.1 cm to 54.3 cm. Diameters range from 0.4 cm to 1.7 cm (mean = 0.8 cm). Seven of the pointed sticks are charred on the tip and may be pokers. Pointed sticks are made of *Salix* sp. (7), *Acer negundo* (5), *Populus* sp. (3), *Sarcobatus vermiculatus* (2), *Fendlera rupicola* (1), *Quercus gambelii* (1), *Juniperus* sp. (1), *Philadelphus microphyllus* (1) and Salicaceae (1).

There are 80 bound twigs of diverse size,

material and construction. Some are whole twigs, others are split. Some are folded or bent, others are straight. Bindings occur medially, on the ends or from end to end. Bound twigs probably served a number of different functions, including traps, arrows, pahos, fetishes and portions of composite artifacts. Bound twigs vary in length from 3.3 cm to 59.0 cm (mean = 16.6 cm) and in diameter from 0.3 cm to 5.5 cm (mean-1.4 cm). Material identifications and details of construction are summarized in Table 134.

There are 10 bound *Phragmites communis* reeds, some of which may be fragments of arrow shafts. The bindings are of sinew (3), *Yucca baccata* leaf (2), *Zea mays* husks (2), *Yucca baccata* cordage (1) and both hide and *Yucca baccata* cord (1). Bound reeds range in length from 3.8 cm to 15.0 cm (mean = 9.6 cm).

There are seven rectangular wooden tablets and three T-shaped tablets. The rectangular tablets measure 5.0 cm to 18.7 cm in length (mean = 8.5 cm), 3.0 cm to 18.7 cm in width (mean

Table 134. Bound twigs.

Species	*Construction (Wrapping)*	*No. of Cases*
Salix sp.	*Salix* sp.	6
	Salix sp. bark	5
	Yucca baccata	9
	Yucca angustissima	2
	Yucca sp. cord	4
	Yucca baccata and cord	1
	Zea mays husk	1
	Populus sp. bark	1
	Gossypium hirsutum	2
	Gossypium hirsutum cord sinew	1
Salix amygdaloides	*Yucca baccata* and *angustissima*	1
Populus sp.	Populus sp.	3
	Yucca baccata	6
	Yucca baccata cord	3
	Yucca baccata leaf and fiber	1
	Yucca angustissima	3
	Yucca angustissima cord	2
	Yucca sp. cord	1
Rhus trilobata	*Rhus trilobata*	1
	Yucca baccata	1
	Yucca baccata cord	1
	Yucca angustissima cord	1
	Yucca baccata and *Zea mays* husk	1
Fendlera rupicola	*Zea mays* husk	1
	Deer hide	1
	Yucca angustissima	1
	Yucca baccata cord	1
	Yucca baccata	2
Sarcobatus vermiculatus	*Yucca baccata*	2
	Yucca sp. cord	2
	Yucca sp.	1
Acer negundo	*Yucca baccata* cord	1
	sinew	1
Juniperus sp.	*Yucca baccata*	1
	Yucca angustissima	1
Philadelphus microphyllus	sinew	1
Apocynum sp.	*Yucca angustissima*	1
Compositae	*Phragmites communis*	1
Alnus sp.	*Yucca* sp. cord	1
Unidentified	*Yucca baccata*	1

= 6.6 cm) and 0.2 cm to 2.8 cm thickness (mean = 0.9 cm). The largest tablet (18.7 cm × 18.7 cm × 2.8 cm) has perforations on two adjacent corners, which suggests that it may be part of a cradle board. Rectangular tablets are made of *Populus wislizenii* (3), *Populus* sp. (1), *Quercus gambelii* (1) and Lagenacia (1). The three T-shaped tablets are all of *Populus wislizenii*. One has *Populus* leaves wrapped around the long axis. Dimensions of T-shaped tablets are 5.6 cm to 9.3 cm (L) × 2.1 cm to 7.2 cm (W) × 0.5 cm to 1.3 cm (Th).

There are 10 wooden rectangles. Nine are *Populus wislizenii* and one is *Pinus ponderosa*. Lengths vary from 3.6 cm to 21.6 cm, widths from 0.6 cm to 5.5 cm and thickness from 0.4 cm to 3.7 cm. Eight rectangles have unbroken ends; seven of these are flat and one is pointed, with a single flat facet. One rectangle has incised parallel lines on all sides.

One complete wooden disk and four fragments were recovered. Disk diameters range from 3.6 cm to 6.2 cm (mean = 4.9 cm) and thickness varies from 0.3 cm to 0.6 cm (mean = 0.6 cm). One disk has two perforations near the edge. The disks are made of *Populus wislizenii* (3), *Populus tremuloides* (1) and *Acer negundo* (1).

Sixty pieces of *Phragmites communis* reed have been cut on at least one end. Twenty-eight of these have been cut straight on both ends. Five have one or two beveled ends. The 30 complete specimens range in length from 2.9 cm to 20.5 cm (mean = 8.1 cm). The broken specimens range up to 45.5 cm in length, and 62 percent are longer than the mean for complete reeds. There is one split reed 6.6 cm long, with ends cut straight and bands of color differentiation indicating the former presence of bindings. One reed (3.0 cm long) has broken ends and is filled with charred cotton. Six reeds, five of which are split, bear decorations. These may be dice or arrow shaft fragments. One reed had incised ticked parallel lines. The other five decorated reeds have colored bands: two red and black, one red and green, one black and one red. These reeds range in length from 7.0 cm to 11.6 cm.

There are 23 pieces of modified gourd or squash rind. Thirteen are *Cucurbita* sp., one is *Cucurbita pepo* and nine are *Lagenaria siceraria*. Six are oval, one is triangular, three are irregular in shape but bear decorations, and four are simply cut on at least one edge. The decorative techniques and elements consist of irregular red painted lines, irregular burned lines and red pigment, and a pattern of two parallel lines and one burned perpendicular line treated with red pigment. Fifteen pieces of rind have perforations; six of these are strung together with yucca cord. Two pieces of rind are sewn together with yucca cord through their perforations. Two other pieces of rind have *Yucca angustissima* ties through their perforations and another rind has a yucca cord through its hole. The pieces of worked rind range in length from 2.6 cm to 16.2 cm (mean = 4.6 cm) and in width from 1.4 cm to 8.5 cm (mean = 3.3 cm).

Many *Zea mays* husks have been coiled, braided, plaited or knotted (see Fig. 112). There are 29 instances of 3-strand braid; these range in length from 5.0 cm to 140.0 cm (mean = 25.7 cm) and in width from 1.7 cm to 4.7 cm (mean = 2.8 cm). Three *Zea* husks have been coiled to form rings, measuring 3.3 cm to 5.0 cm in diameter. One husk has been plaited into a zig-zag shape and is 9.5 cm long and 3.5 cm wide. This may be a lightning effigy. Two other folded husks have been plaited together to form an artifact 24.3 cm long and 6.0 cm wide. There are also two twisted *Zea mays* stems (lengths = 17.3 cm and 72.0 cm) and a shank which has been skewered on a sharp pointed *Quercus* sp. shaft (length = 26.5 cm).

Six wooden spheres were recovered. One is a highly polished *Quercus gambelii* shouldered sphere which ends in a shaft. The sphere diameter is 2.9 cm and the shaft fragment is 3.5 cm long. Another sphere with a handle is made of *Juniperus scopulorum*; its diameter is 3.4 cm. There are two hollow spheres, one of which is bisected. One is *Populus* sp. and the other is *Populus wislizenii*. Diameters are 8.6 cm and 3.9 cm. There is also a bisected polished sphere (diameter = 3.3 cm) and a rough cut and charred sphere (diameter = 1.6 cm) of either *Pinus ponderosa* or *Pseudotsuga menziesii*.

A beautifully formed, polished concave-convex rectangular "platter" of *Acer negundo* measures 33.0 cm long and 17.3 cm wide. Its functions is unknown.

Various pieces of wood and bark have been use-worn, charred, cut, pigment-stained, looped or knotted. These artifacts are summarized in Table 135.

There also are a number of modified non-

Table 135. Miscellaneous modified wood.

Modification	*Species*	*No. of Cases*
Cut sticks	*Populus* sp.	3
	Populus wislizenii	1
	Acer negundo	3
	Salix sp.	3
	Cercocarpus sp.	1
	Cercocarpus montana	1
	Fendlera rupicola	1
	Philadelphus microphyllus	1
	Cleome serrulata	1
	Juniperus sp.	1
	Rhus trilobata	1
	Cowania mexicana	1
	Amelanchier utahensis	1
	Compositae	1
	Unidentified	1
Cut slats	*Populus wislizenii*	5
	Populus sp.	4
	Pseudotsuga menziesii	4
	Quercus gambelii	3
	Acer negundo	3
	Pinus ponderosa	1
	Pinus ponderosa or *Pseudotsuga menziesii*	1
	Juniperus sp.	1
Cut chip	*Quercus gambelii*	14
	Populus sp.	5
	Populus wislizenii	4
	Acer negundo	5
	Unidentified	1
Cut slivers	*Populus wislizenii*	3
	Populus sp.	1
	Pseudotsuga menziesii	2
	Pseudotsuga menziesii or *Pinus ponderosa*	1
	Salicaceae	1
Cut bark	*Populus tremuloides*	26
	Populus sp.	1
	Pinus ponderosa	1
Cut root	*Quercus gambelii*	1
	Unidentified	1
	Cercocarpus sp.	1
Cut logs	*Populus* sp.	2
	Acer negundo	1
Looped twigs	*Salix* sp.	19
	Salix exigua	1
	Populus sp.	12
	Rhus trilobata	12
	Quercus sp.	1
Knotted twigs	*Salix* sp.	37
	Salix exigua	3
	Salix amygdaloides	1
	Populus sp.	7
	Rhus trilobata	4
	Unidentified	1
Bent twigs	*Salix* sp.	8
	Salix exigua	2
	Populus sp.	5
	Fendlera rupicola	1
	Rhus trilobata	1
	Unidentified	1

continued

Table 135. Miscellaneous modified wood—Continued

Modification	*Species*	*No. of Cases*
Knotted bark	*Salix* sp.	24
	Salicaceae	2
	Rhus trilobata	2
	Populus sp.	1
	Juniperus sp.	1
	Apocynum sp.	1
	Unidentified	1
Looped Bark	*Salix* sp.	8
	Rhus trilobata	4
	Populus sp.	1
Charred sticks	*Salix* sp.	10
	Salix exigua	1
	Salicaceae	2
	Juniperus sp.	2
	Rhus trilobata	2
	Populus sp.	1
	Philadelphus microphyllus	1
	Sarcobatus vermiculatus	1
Pigment stained	*Acer negundo*	4
	Populus wislizenii	2
	Populus sp.	1
	Fendlera rupicopla	2
	Alnus sp.	1
	Yucca sp. root	1
	Quercus gambelii	1
	Quercus turbinella	1
	Salix sp.	1
Perforated bark	*Populus tremuloides*	3
	Acer negundo	1
Beveled bark chips	*Populus tremuloides*	3
	Populus sp.	3
Modified bark	*Populus tremuloides*	4
(rounded edges)	*Populus* sp.	1
Painted bark	*Populus tremuloides*	1

woody vegetal artifacts. Four are constructed of yucca leaves intertwined in a technique called box weave. Three of these are of *Yucca angustissima* and one is of *Yucca baccata*. Three specimens have the end leaves bound, two with yucca and one with cotton cord. The artifacts range in length from 2.0 cm to 4.5 cm and in width from 1.0 cm to 2.2 cm. There is one instance of braided roots, possibly secondary *Yucca* sp. roots (7.0 cm long). There is a bunch of overhand knotted *Phragmites communis* and a knotted *Phragmites* rhizone. Six stems of *Scirpus americanus/Typha latifolia* have been square knotted and one piece has been looped. Six *Juglans major* fruits (walnuts) have been ground on one end. A group of 107 walnuts was found together in a yucca basket. These may be beads or portions of rattles. Two juniper berries have been perforated, possibly for use as beads; one has an end ground flat.

Summary of Miscellaneous Wooden and Vegetal Artifacts

The ceremonial objects give evidence of typical puebloan ritual life: the use of prayer sticks and fetishes, the ritual importance of corn and of feathers, and the practices of ritual smoking and gaming (dice and dart-hoop game). The paucity of primary context deposits limits meaningful generalizations about spatial distribution of ceremonial objects. The cache of prayer sticks

from Structure 81 in the Tower Corridor seems to have been part of a ritual offering, due to its association with other items of a ceremonial nature. The basket of ceremonial items from Room 88 in the South Plaza lacks associated artifacts, but it may indicate that Room 88 was a storage room for ritual paraphernalia. Most ceremonial items (see Table 127) date to PIII, although fetishes, prayer sticks and dice are found in earlier deposits.

The subsistence artifacts provide evidence of hunting, gathering and agriculture. Most artifacts again date to PIII, but all items except nets and bows are represented in earlier periods (see Table 128). Food processing and cooking activities are evidenced by such artifacts as scrapers, paddles, scoops, forks, stirring sticks, rack supports, fire hearths, fire drills, torches and pokers. In general, the temporal and spatial distribution of such artifacts is random. They correlate with large trash deposits of perishable materials.

Chapter 20

The Antelope House Basketry Industry

Basketry, as discussed here, includes several distinct kinds of items, including rigid and semirigid containers, or baskets proper, matting and bags.

Matting includes items which are essentially two dimensional or flat; baskets are three dimensional. Bags may be viewed as intermediate forms, since they are two dimensional when empty and three dimensional when filled. As Driver (1961: 159) points out, these artifacts can be treated as a unit because the overall technique of manufacture is the same in all instances. Specifically, all forms of basketry are manually woven, without the aid of frame or loom. Since all basketry is woven, it is technically a class or variety of textile, although that term sometimes is restricted to cloth fabrics.

There are three major subclasses of basket weaves and these generally are mutually exclusive: twining, coiling and plaiting.

Twining denotes a subclass of basket weaves manufactured by passing moving (active) horizontal elements, called wefts, around stationary (passive) vertical elements, or warps. Twining techniques may be employed to produce containers, mats and bags, as well as fish traps, cradles, hats, clothing and other "atypical" basketry forms.

Coiling denotes a subclass of basket weaves manufactured by sewing stationary horizontal elements (the foundation) with moving vertical elements (stitches). Coiling techniques are used almost exclusively in the production of containers, hats and, rarely, bags. Mats and other forms are seldom, if ever, produced by coiling.

Plaiting denotes a subclass of basket weaves in which all elements pass over and under each other without engagement. For this reason, plaited basketry is technically described as unsewn. Plaiting may be used to make containers, bags and mats, as well as a wide range of other nonstandard forms.

Procedures

Some 616 complete or fragmentary specimens of basketry were recovered from Antelope House. These include 31 pieces of twining, 77 pieces of coiling, 466 pieces of plaiting and 42 complete or fragmentary miscellaneous fiber constructions not specifically assignable to any of the three major subclasses of basketry. (Analysis of an expanded sample is reported here; cf. Adovasio and Gunn 1975).

All of the specimens described and discussed here initially were cleaned of soil, bat or rodent dung and other surface contaminants, where necessary. The type and character of the contaminants was then tabulated. Visual exam-

ination was done with the aid of a seven-power hand lens or, where applicable and warranted, with a variable power stereoscopic microscope. In extreme cases of technical complexity or obscurity, specimens were carefully disassembled to insure proper recognition of the manufacturing techniques employed. All specimens were measured in metric units with a Helios needle-nosed dial caliper.

Twined basketry specimens were divided into five structural types, based on the number and sequence of warps engaged at each weft crossing and the spacing of the weft rows. All twined specimens were analyzed, where feasible, for selvage, method of starting, method of insertion of new warp and weft elements, method of preparation of warps and wefts, form, wear patterns, function, decorative patterns and mechanics, type and mechanics of mending and raw materials.

Coiled specimens were divided into 14 structural types, based on the kind of basket wall or foundation technique used and the type of stitch employed. All specimens were analyzed, where warranted, for type of rim finish, method of starting, work direction, decorative patterns and mechanics, type and mechanics of mending, form, wear patterns, function, method and preparation of foundation and sewing elements, raw materials and, where available, type of splice.

Plaited basketry specimens were divided into four structural types, based on interval of element engagement. Plaited specimens were analyzed for selvage treatment, shifts, method of preparation of elements, form, wear patterns, function, type and mechanics of mending and decorative patterns and mechanics.

Miscellaneous fiber constructions not directly assignable to any of the major Antelope House basketry subclasses and/or structural types were allocated to 11 arbitrary categories, based upon predominant technological, structural or formal attributes. All miscellaneous fiber constructions were analyzed for method of preparation of elements, wear patterns, function, decorative patterns and mechanics, type and mechanics of mending and raw materials.

The structural types and residual categories established by the above procedures and all other pertinent descriptive data are presented below.

It should be noted that the term "type" is used here purely as a classificatory label. Whether or not these types reflect fixed mental templates of the Antelope House basket makers is a question left to others. The descriptive terms utilized are those employed by Adovasio (1974a, 1976). For those unfamiliar with these terms, a glossary follows.

Glossary

The following glossary is not complete and is not intended as a guide to basketry analysis. Its sole purpose is to acquaint the reader with terms used in this chapter. Portions of this glossary are adapted from Mason (1904), Morris and Burgh (1941), Cressman (1942) and Adovasio (1974a).

Bunched Foundation—a coiling foundation composed of two or more elements placed side by side or in triangular arrangement so that the basket wall has a double thickness of elements in each coil. Synonym: Multiple foundation.

Bundle—a flexible foundation element of plant material used alone or in combination with rods in coiled basketry. It may consist of loose fibers, a mass of stems or twigs, a single shredded leaf or, rarely, cordage. The function of the bundle is to engage the stitches by which one coil is fastened to another as well as to provide a framework for the coil itself. Synonyms: Grass foundation, fiber foundation, multiple reed foundation.

Bundle with Rod Core—a foundation element in coiled basketry consisting of a single, usually whole rod surrounded by a fiber bundle. Synonym: Rod in bundle.

Center—the point at which the production of a coiled or twined basket or bag is initiated. Mats possess no center. There are several types of coiled centers including the so called normal or continuous coil type, the oval or flattened continuous coil type, the plaited center and the overhand knot center. Similarly, there are many types of twined centers based on the initial arrangement of the warps (see Mason 1904, Cressman 1942, Adovasio 1976). Synonym: Start.

Coil—the structural unit of coiled basketry. It consists of a foundation enclosed by a sheath formed by successive stitches.

Close Coiling—a variety of coiled basketry in which successive circuits of the coil are bound closely together by the stitches. The stitches in

this variety of coiling may be interlocking, non-interlocking or intentionally split on the non-work surface, work surface or on both surfaces.

Close Twining—a form of twined basketry in which the weft rows are so tightly spaced as to conceal the warp. Both simple and diagonal twining may employ this weft pattern, though it is more commonly used with simple twining for aesthetic effect.

Diagonal Twining—a common variety of twined basketry in which paired warps are alternately engaged at each weft crossing. Each successive weft row engages alternate warps of each pair, producing a diagonal effect on the surface of the finished item. The stitch slant may be S or Z and the weft rows may be closely spaced or spaced at intervals. Synonym: Twill twining.

Double Stitch—a pair of stitches sewn through a single hole made by the awl. Double stitches frequently are used as expansion stitches.

Expansion Stitch—an extra stitch (a double stitch or a wrapping stitch) used at or near the center of a coiled basket to keep the normal stitches from separating too widely, owing to the rapid expansion and sharp curve of the coiling spiral.

Fag End—the end of a stitch which is present on the work surface of a coiled basket. It marks the place where a new length of stitch is spliced on. It may be a visible stub or it may be a long end folded under the stitches. The stub may likewise be concealed under a stitch. At or near the same point on the non-work surface of the basket, the moving end of the exhausted stitch is present.

False Braid—an ornamental finish on the rim of a coiled basket. False braid is produced by manipulating a single stitch in various figure-8 patterns to produce a herringbone design.

Gap—the distance between successive stitches in coiled basketry. The gap may range from zero in well-made close coiled basketry to several centimeters in open coiled basketry. The term also is used to denote the distance between individual coils in open coiling.

Interlocking Stitch—a type of stitch in coiled basketry which passes diagonally through the top of the stitch immediately below. In so doing, it may pierce the foundation element or simply encircle it.

Intricate Stitch—a type of stitch used only in open coiling. It is produced by a manipulation of the sewing element so that it engages adjacent foundation units one or more times and is wrapped in a false knot around its standing portion to accomplish the spacing of the coils.

Interval—in plaited basketry, this term denotes the number of elements or strips in each set that are crossed over by strips in the other set. Intervals are usually designated numerically. In simple plaiting, the interval is under one over one (1/1). Any interval in excess of this (i.e., 2/2, 3/3, etc.) produces some variety of twill plaiting.

Moving End—the end of an exhausted stitch present on the non-work surface of a basket. The moving end may be a visible stub, long end folded under the stitches or close clipped end deeply buried in the coil itself. At or near the same point on the work surface of the basket, the fag end of the new stitch is present.

Non-Interlocking Stitch—a type of stitch in coiled basketry which engages the foundation of the coil below without passing through another stitch. In so doing, it may pierce the foundation or simply encircle it.

Non-Work Surface—the surface of a coiled basket upon which the sewing awl emerges. Synonyms: Back, left side, reverse stitches.

Open Coiling—a variety of coiled basketry in which the coils are not bound closely together, but are separated by the use of an intricate stitch. At the middle of each intricate stitch is a false knot of varying complexity. The intricate stitch may be used alone or in combination with wrapping stitches; the resultant fabric is open, with gaps exposed along the coil. Synonyms: Spaced coiling, sifter coiling, Fuegian coiling.

Open Twining—a form of twined basketry in which the weft rows are spaced at intervals and regularly expose the warp. Both simple and diagonal twining may employ this weft pattern.

Rod—a rigid or semirigid foundation element used alone or in combination with other rods, bundles or welts. It may consist of a stick, twig or reed, whether complete (whole) or split lengthwise (halved), with or without bark or cortex.

Self Rim—the rim of a coiled basket sewn in the same technique as the rest of the basket.

Selvage—the edge finish of a twined or plaited mat or bag or the rim of a twined or plaited container.

Shift—a sequence of changes in the interval of twill plaiting by which patterns in the fabric are produced. Shifts are employed in selvage treatments as well as in the general body of the fabric. Several different shifts often occur in the same specimen. The interval which ordinarily is 2/2 may be altered to 2/3, then altered again to 3/3 and so on.

Simple Twining—a common variety of twined basketry in which "single" warps are engaged between each weft crossing. Each succeeding weft row engages the same warps at the same interval. In this type of twining, warps may actually number more than one, but whatever their number, they function as a single unit. The stitch slant may be down to the left (S) or down to the right (Z) and the weft rows may be closely spaced or spaced at intervals. Synonym: Plain twining.

Splice—a point along a coil where one stitch ends and a new one is introduced. It is marked by the presence of one fag end on the work surface and the moving end on the non-work surface. In twined basketry, splice refers to the method of insertion of new warp and weft elements during construction.

Split Stitch—a type of stitch in coiled basketry which is bifurcated to receive a stitch from the coil immediately above it. Stitches may be regularly (that is, intentionally) split on the work, non-work and both surfaces. Accidental (that is, non-intentional) splitting may also occur on one or both surfaces through carelessness. Synonym: bifurcated stitch.

Stacked Foundation—a coiling foundation in which elements are arranged one above the other as logs in a cabin wall. Synonym: Vertical foundation.

Stitch—the element that is sewn over the foundation in coiled baskets. It may be a strip of wood, bark, leaf or plant fiber. Synonym: Splint.

Stitch Slant—a term used to denote the pitch or lean of the wefts in twined basketry. The stitch slant may be down to the left or down to the right. When the stitch slant is down to the left it is commonly called S, since the paired wefts have in fact been S-twisted when viewed in a vertical position. Conversely, the down to the right slant is called Z for the same reason. Stitch slant occasionally is altered in the same specimen for decorative effect.

Strips—the weaving elements in plaited basketry. Strips usually are long thin flat sections of leaf, bark, plant fiber or wood.

Tapered Twill—a technique of twill plaiting in which a curve is imparted to the wall of a container by decreasing the width of the plaiting strips as they approach the rim.

Twill Plaiting—a variety of plaited basketry in which the weaving elements pass over each other in intervals of two or more (2/3, 2/2, etc.). Synonyms: Twilling, chevron weave, herringbone weave, diagonal plaiting, twilled twos.

Weft—the moving horizontal element in twined basketry which engages the warps. Wefts usually are paired, although trebled and even quadrupled wefts are not unknown.

Welt—a foundation element in coiled basketry used in conjunction with one or more rods. A welt is a small flattened stick, twig or strip of fiber which is stacked vertically on a single rod or employed as the apex element in a bunched foundation. Synonym: Splint.

Work Direction—the direction in which a stitch is sewn along the foundation of a coiled basket.

Work Surface—the surface of a coiled basket on which the sewing awl is inserted to make a path for the stitch. Synonyms: Front, right side.

Wrapping Stitch—a stitch which makes a single revolution around a foundation unit without engaging any part of the coil below.

Wrapped Twining—a decorative as well as basic contruction technique in twined basketry. The technique makes use of a single element lying outside of the weft as it crosses the warp on the outer surface of the basket. Rather than following the weft behind the warp, it passes vertically between the two warps. The element is then brought out over the outer weft element, as it crosses the succeeding warp. The wrapping element never passes behind a warp. If wrapped twining is employed as a basic construction technique, there is one fixed weft (the inner weft) and one running weft (the outer weft).

Twining

The 31 pieces of twined basketry recovered are assigned to five structural types, which are described below by numerical prefix. Table 136 presents the distribution of twined basketry by type, raw materials used, period and provenience.

Table 136. Distribution of twined basketry by type, raw material, period and provenience.

Key
The first Roman numeral indicates twining type; the set of letters designates weft and warp material of specimen, in that order; the Arabic numeral gives number of specimens.

P = *Phragmites* sp.
S = *Scirpus* sp.
Sa = *Salix* sp.
T = *Typha* sp.
Y = *Yucca* sp.
Ya = *Yucca angustissima*
Yb = *Yucca baccata*

	South Area					*South Room Block*			
	South Plaza	*South Plaza Floor 2*	*Kiva D*	*Floor 1*	*Room 82*	*Tower Corridor Floor 1*	*Room 1*	*Room 9*	*Room 23*
BMIII									
PI									
PII				IV-YaS-1			II-YY-2		
PIII									IV-YaS-1
EPIII	V-YP-1 IV-TT-1 IV-YS-1	IV-YS-1	IV-YT-1						
MPIII					IV-TT-1			IV-ST-1	
LPIII	IV-YaS-1 IV-YaT-1					IV-YaS-1			
Navajo									
Unknown	IV-SS-1 IV-YT-1 IV-YaS-3								
TOTAL	10	1	1	1	1	1	2	1	1

	Central Room Block		*North Room Block*					*North Area*	
Room 29	*Kiva B Annex*	*Room 42*	*Room 6*	*Room 17 Floor 1*	*Room 18*	*Room 35*	*North Terrace*	*North Area*	Totals
									0
								III-YT-1	1
									3
									1
									5
II-YY-1			IV-YaYa-1						4
	IV-YaS-1	III-YbT-1		IV-YS-1					6
									0
					IV-YSa-1	I-YY-1 IV-YS-1	IV-YaS-1	IV-YS-2	11
1	1	1	1	1	1	2	1	3	31

Type I: Close Simple Twining, Z-Twist Weft
Number of specimens: 1.
Type of specimen: Wall fragment with selvage
Form represented: Petate.

Technique and Comments: This is plain twined weaving over single warps. Wefts are paired unspun elements; warps also are unspun. Weft rows are closely spaced to conceal warps. Warps are arranged radially and terminate in a three-element braided selvage formed by the exhausted weft rows. Immediately below the selvage, a series of five holes, *ca.* 2.15 mm in diameter, circumscribes the extant rim of the specimen. These holes presumably served as points of attachment for a cordage reinforcement. The center is absent, but the method of starting appears to be radial twining on the crossed warps. The specimen is flexible, undecorated, unmended, unpitched and not naturally watertight. Wear patterns are undiagnostic.

Measurements: Diameter of warps, 3 mm; diameter of wefts, 2 mm; warps per centimeter, 3; wefts per centimeter, 2; gap between weft rows, 0.



Figure 114. Type II sandal fragments; close simple twining, S-twist weft.

Type II: Close Simple Twining, S-Twist Weft
(Fig. 114)
Number of specimens: 3.
Type of specimens: Wall fragments with selvage.
Forms represented: Sandals.

Technique and Comments: This is plain twined weaving over single warps. Warps and wefts are 2-ply Z-spun S-twist cordage. Weft rows are closely spaced to conceal warps. No end selvages are present; side selvages are identical in all specimens. Wefts at the final warp crossing are folded at right angles to the weft row (parallel to the terminal warp), then rewoven back into the body of the specimen to form the next weft row. This selvage treatment is hereafter called continuous weft. One specimen has new wefts inserted via an overhand knot splice with the exhausted weft course. All specimens are flexible, undecorated, unmended, unpitched and not naturally watertight. All specimens exhibit heavy wear on one surface and moderate wear on the other.

Measurements. Range in diameter of warps, 1–2 mm; mean diameter of warps, 1.66 mm; range in diameter of wefts, 1 mm; mean diameter of wefts, 1 mm; range in warps per centimeter, 3–6; mean warps per centimeter, 4.33; range in wefts per centimeter, 11–30; mean wefts per centimeter, 17.66; range in gap between weft rows, 0.

Type III: Open Simple Twining, Z-Twist Weft
Number of specimens: 2.
Type of specimens: End selvages.
Forms represented: Matting.

Technique and Comments: This is plain twined weaving over "single" warps. In one specimen, the warp is actually a single element; in the other, three bunched warps function as a unit. The paired wefts are 2-ply S-spun Z-twist cordage; warps are unspun. Although only the final weft row is present on both specimens, it is clear that wefts were spaced at intervals to expose warps. Specimens are flexible. End selvage treatment consists of folding the warps at a 180° angle back into the terminal weft crossing, where they are then truncated. After each warp crossing, wefts are reinforced with an overhand knot before engaging the next warp. This technique minimizes fraying of the selvage and provides





Figure 116. Type IV mat fragment with twilled selvage.

Figure 115 (left). Type IV mat fragment; open simple twining, S-twist weft.

additional rigidity to the edge of the mat. Both specimens are undecorated, unpitched and not naturally watertight. In one specimen, the weft row has been mended twice via splicing with a square and a double overhand knot. Wear patterns are pronounced on both surfaces of each specimen.

Measurements: Range in diameter of warps, 3.90–24.85 mm; mean diameter of warps, 13.38 mm; diameter of wefts, 3.20 mm; warps per centimeter, 1; wefts per centimeter, 1.

Type IV: Open Simple Twining, S-Twist Weft
(Fig. 115, 116, 117)
Number of specimens: 24.
Type of specimens: Complete, 1; wall fragments with selvage, 5; wall fragments without selvage, 18.
Forms represented: Bag, 1; matting, 23.

Technique and Comments. This is plain twined weaving over "single" warps. In nine specimens, the warp is a single element; the remaining specimens include examples of doubled (2), trebled (7) and quadrupled (6) warps functioning as unitary elements. Wefts are always paired and in-



Figure 117. Type IV bag fragment; open simple twining, S-twist weft, with 180° folded selvage.

clude 22 examples of 2-ply Z-spun S-twist cordage and two examples of unspun fiber. Weft rows are spaced at intervals to expose warps. Specimens are flexible. Side selvages of the fragmentary specimens include three examples in which the weft row is terminated with an overhand knot. End selvages include one example in which the warps are simply truncated about 2 cm after the final weft row and one example in which warps are consistently folded at a 122° angle and plaited in a 2/2 interval. The complete specimen of this type is a unique elongate bag made of a single small *Yucca* sp. plant with the stem truncated. The leaves of the plant form the warps, which are radially twined with 2-ply unspun wefts. End selvage is of the 180° variety. New wefts are added via overhand knot splices to exhausted weft rows. All specimens are undecorated, unmended, unpitched and not naturally watertight. The matting fragments exhibit moderate to heavy wear on one or both surfaces.

Measurements: Range in diameter of warps, 2.6–12.30 mm; mean diameter of warps, 11.86 mm; range in diameter of wefts, 1–3.40 mm; mean diameter of wefts, 2.10 mm; range in warps per centimeter, 0.8–3; mean warps per centimeter, 1.46; wefts per centimeter, 1; range in gap between weft rows, 15–151 mm; mean gap between weft rows, 22.1 mm.

Type V: Open Diagonal Twining, S-Twist Weft
(Fig. 118)
Number of specimens: 1.
Type of specimen: Wall fragment without selvage.
Form represented: Matting.

Technique and Comments: This is diagonal twined weaving over paired warps. The paired wefts are 2-ply S-spun Z-twist cordage; warps are undecorticated cane. Weft rows are irregularly spaced at intervals to expose warps. Specimen is flexible, undecorated, unmended, unpitched and not naturally watertight. Weft rows exhibit heavy attrition wear, while the cane warps show sheen from extensive use on both sides.

Measurements: Diameter of warps, 11.9 mm; diameter of wefts, 1.85 mm; warps per centimeter, 1; wefts per centimeter, 1; mean gap between weft rows, 6.8 cm.



Figure 118. Type V mat fragment; open diagonal twining, S-twist weft.

Coiling

The 77 pieces of coiled basketry recovered from Antelope House are assigned to 14 structural types, which are described below by numerical prefix. Table 137 presents the distribution of coiled basketry by type, raw materials used, period and provenience.

Type VI: Close Coiling, Bundle Foundation, Stitch Type Unknown
Number of specimens: 1.
Type of Specimen: Base fragment.
Form represented: Unknown.
Work Direction: Right to left.

Technique and Comments: Strictly speaking, this "type" is not a type, since no stitch variety is positively distinguishable. The specimen is the initial, complete circuit of a base with a foundation consisting of a retted fiber bundle. Method of starting is continuous coil. The extant stitches appear to be non-interlocking, but this is no guarantee that the rest of the specimen was sewn with this variety of stitch. Stitches are closely spaced and conceal the foundation. The specimen is semiflexible. Work surface and all other pertinent details of construction are not discernible. The extant circuit, or coil, is undecorated, unmended, unpitched and not naturally watertight. There are no wear patterns.

Type VII: Close Coiling, Whole Rod Foundation, Interlocking Stitch (Fig. 119 through 122)
Number of specimens: 26.
Type of Specimens: Complete, 3; wall fragments, 4; rim fragments, 4; base fragments, 14; handles, 1.
Forms represented: Shallow trays, 18; shallow bowls, 5; unknown, 3.
Work direction: Right to left.



Figure 119. Type VII base fragment of tray; close coiling, whole rod foundation, interlocking stitch, with reinforced continuous coil center; work surface.

Table 137. Distribution of coiled basketry by type, raw materials, period and provenience.

Key
The first Roman numeral indicates coiling type; the set of letters designates foundation, stitch, and, if present, bundle material of specimen, in that order; the Arabic numeral gives number of specimens.

S = *Salix* sp.
R = *Rhus* sp.
Y = *Yucca* (unknown species)
Ya = *Yucca angustissima*
U = Unknown

	South Area			*South Room Block*					
	South Plaza	*Kiva D*	*Structure 8*	*Room 82*	*Room 1*	*Room 9*	*Room 21*	*Room 22*	*Room 23*
BMIII									
PI			XVII-SSY-1						
PII	XVII-SSY-1	XVI-RRY-1 XVII-SRY-1			VII-SR-1				
PIII	XVII-RRY-1								XVII-URY-1
EPIII	VII-SR-4 XVII-UY-1 XVII-SSY-1	XVII-SSY-1			VII-SR-1		XVII-SSY-1	VII-RR-1	
MPIII				VII-SR-1			VII-RR-2 VII-SR-1		
LPIII	VI-SR-1 XVII-SYaT-1				VII-RR-1	XVII-RSY-1	VII-RR-1 XVII-SR-2		
Navajo	VII-SR-2 XVII-SSY-1	XI-RR-1							
Unknown	VII-RR-1 XIII-SSY-1 XVII-SSY-1								
TOTAL	16	4	1	1	3	1	7	1	1

Central Room Block

Room 29	*Room 29 Floor 3*	*Room 29 Burial 11*	*Room 30*	*Kiva B*	*Kiva B Annex*	*Room 32*	*Room 40*	*Room 42*
VII-SR-3 XII-SYY-1 XVII-SSY-1								
VII-RR-1		XVII-SSY-1	VII-SS-1					
	XVII-SSY-1		VII-SR-1 XI-RR-1	VI-YR-1 XVII-RRY-1	XV-SS-1 XVII-SSY-2	XVII-SSY-2	X-RYaY-1	XVII-SSY-1
6	1	1	3	2	3	2	1	1

continued

Table 137. Distribution of coiled basketry by type, raw materials, period and provenience—Continued

Key

The first Roman numeral indicates coiling type; the set of letters designates foundation, stitch, and, if present, bundle material of specimen, in that order; the Arabic numeral gives number of specimens.

S = *Salix* sp.
R = *Rhus* sp.
Y = *Yucca* (unknown species)
Ya = *Yucca angustissima*
U = Unknown

	North Room Block							
	Room 44	*Room 48 Floor 1*	*Room 54 Floor 1*	*Room 5*	*Room 6*	*Room 17*	*Room 38*	*Room 46*
BMIII			XIX-RR-1					
PI								
PII								
PIII								
EPIII								
MPIII								
LPIII	XIV-SS-1 XVII-SSY-2			XVII-SSY-1	VII-SR-1	XVII-SRY-1	VIII-RR-1	VII-RR-1
Navajo								
Unknown		XVII-SRYa-2						
TOTAL	3	2	1	1	1	1	1	1

		North Area	
Structure 66	*North Terrace*	*North Area*	Totals
			1
XVII-SSY-1	XVI-RRY-1 XVII-SSY-1 XVII-RRY-1		5
			9
		XVIII-SS-1	3
			10
	VIII-RR-1		8
	VII-RR-1 IX-SS-1		29
			4
XVII-SSY-1	XVII-SSY-2		8
2	8	1	77

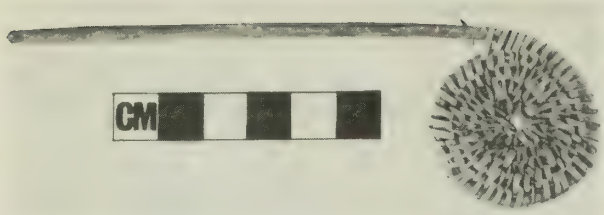


Figure 120. Type VII base fragment of tray, with continuous coil center; work surface.

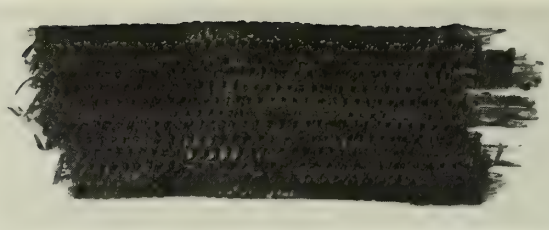


Figure 122. Type VII "handle" fragment; note double self rim and binding stitch mend; non-work surface.

Figure 121. Type VII complete shallow bowl; not splices with fag ends bound under and self rim; work surface.

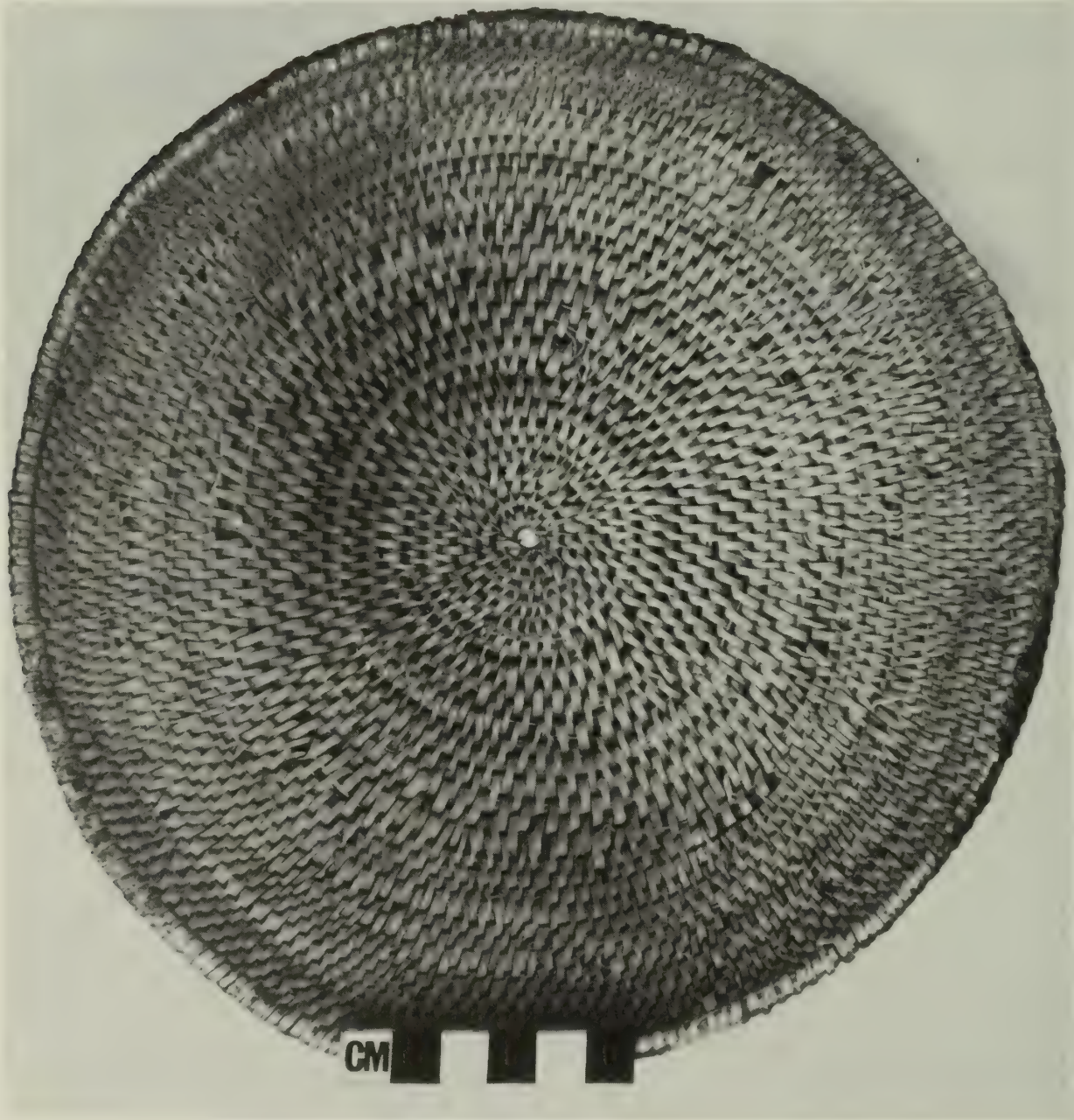




Figure 123. Type VIII base fragment of tray; close coiling, whole rod foundation, non-interlocking stitch, with continuous coil center; non-work surface.

Technique and Comments: A single whole rod is sewn with interlocking stitches, which wrap rather than pierce the rod. In 13 specimens, the cortex (or bark) is left on the rods; in the remainder, rods are decorticated. Fifteen specimens exhibit accidental splitting on the non-work surface only. There is a gap between the stitches exposing the foundation on 11 specimens. Work surface is concave on 17 specimens and convex on six. The work surface is not discernible on the remaining specimens. All representatives of this type are rigid. Centers include nine continuous coil, five reinforced continuous coil and two oval. Rim finishes include six self and one false braid in a 2/2 interval. The complete specimens include two sloping wall shallow bowls and one miniature bowl. The "handle" consists of 14 rods laid side by side with a "rim" on both margins. Handled baskets are very rare in Anasazi sites and the true function of this specimen is unknown. All specimens are undecorated and unpitched. Three are naturally watertight, due to the tightness of the weave. Two specimens, including one base fragment and the "handle," have been mended by addition of a row of binding stitches to two or more adjacent coils. Splices include 12 examples of fag and moving ends bound under, four of fag ends clipped short and moving ends bound under, and one each of fag and moving ends clipped short, and fag ends clipped short and concealed under stitch with moving ends bound under. On one specimen, fag ends are clipped short and moving ends are obliterated by heavy wear. Eight specimens exhibit moderate to heavy wear. Five are worn on the non-work surface, one on the work surface, and two on both surfaces.

Measurements (all specimens): Range in diameter of coils, 2–7 mm; mean diameter of coils, 3.9 mm; range in width of stitches, 1–3 mm; mean width of stitches, 2.13 mm; range in gap between stitches, 0–5.35 mm; mean gap between stitches, 0.84 mm; range in coils per centimeter, 1–4; mean coils per centimeter, 2.72; range in stitches per centimeter, 2.5–8; mean stitches per centimeter, 4.16.

Measurements (complete specimens): Container 1—maximum diameter of rim, 205 mm; maximum diameter of base, 125 mm; maximum depth, 80 mm. Container 2—maximum diameter of rim, 219 mm; maximum diameter of base, 113 cm; maximum depth, 61 mm. Container 3—maximum diameter of rim, 24 mm; maximum diameter of base, 13 mm; maximum depth, 11 mm.

Type VIII: Close Coiling, Whole Rod Foundation, Non-Interlocking Stitch (Fig. 123)
Number of specimens: 2.
Type of specimens: Base fragments.
Forms represented: Shallow trays.
Work direction: Right to left, 1; left to right, 1

Technique and Comments: A single whole rod is sewn with non-interlocking stitches, which wrap rather than pierce the rod. In one specimen, the cortex is left on the rods; in the other, rods are decorticated. One specimen exhibits accidental splitting of the stitches on both surfaces, while the other shows accidental splitting on the non-work surface only. There is an occasional gap between the stitches exposing the foundation on both specimens. Work surface is concave. Specimens are rigid. Both centers are continuous coil. The specimens are undecorated, unmended, unpitched and not naturally watertight. Splices have fag and moving ends bound under. No wear patterns are discernible.

Measurements: Range in diameter of coils, 2.5–4 mm; mean diameter of coils, 3 mm; range in width of stitches, 2–3 mm; mean width of stitches, 2.58 mm; range in gap between stitches, 0–2 mm; mean gap between stitches, 0.83 mm; range in coils per centimeter, 3–4; mean coils per centimeter, 3.5; range in stitches per centimeter, 4–6; mean stitches per centimeter, 5.

Type IX: Close Coiling, Two-Rod Horizontal Foundation, Non-Interlocking Stitch (Fig. 124)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Unknown.
Work direction: Right to left.

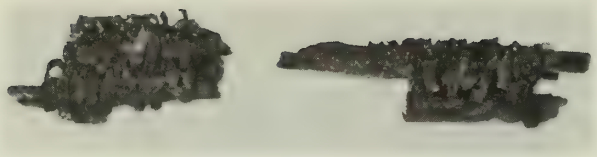


Figure 124. Type IX wall fragment; close coiling, two rod horizontal foundation, non-interlocking stitch; non-work surface.

Technique and Comments: Two decorticated whole rods arranged horizontally (side-by-side) are sewn with non-interlocking stitches, which wrap rather than pierce the rods. Some accidental splitting of the stitches occurs on both surfaces. There is no gap between the stitches. Work surface is not detectable. Specimen is rigid, undecorated, unmended and unpitched, although probably watertight owing to the extreme tightness of the weave. Because the specimen is fragmentary, splice type and wear patterns are not discernible.

Measurements: Diameter of coils, 1.25 mm; width of stitches, 0.88 mm; gap between stitches, 0; stitches per centimeter, 8.

Type X: Close Coiling, Rod with Lateral Bundle Foundation, Non-Interlocking Stitch (Fig. 125)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Shallow tray.
Work direction: Right to left.

Technique and Comments: A single decorticated whole rod and a horizontally arranged retted fiber bundle are sewn with interlocking stitches. The bundle is laid on the convex, or outer, surface and the rod on the concave, or inner, surface of the basket. The size of the bundle is two to three times that of the rod. A small portion of the bundle is drawn around the top and bottom of the rod, providing points of engagement for the stitches. Some accidental splitting of the stitches occurs on the non-work surface. There is no gap between the stitches. Work surface is concave. The specimen is rigid, undecorated, unmended and unpitched, but is watertight owing to the tightness of the weave. Splice type is not discernible. Wear is pronounced on the convex surface, while a heavy use sheen is present on the concave surface.

Measurements: Diameter of coils, 10.12 mm; width of stitches, 2.58 mm; gap between stitches, 0; coils per centimeter, 1; stitches per centimeter, 4.

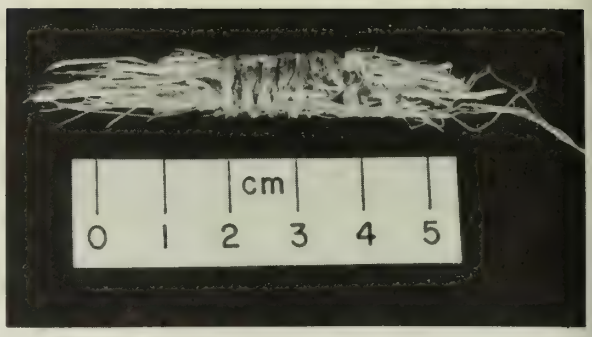


Figure 125. Type X wall fragment of tray; close coiling, rod with lateral bundle foundation, non-interlocking stitch; non-work surface.

Type XI: Close Coiling, Two-Rod Stacked Foundation, Non-Interlocking Stitch (Fig. 126)
Number of specimens: 2.
Type of specimens: Wall fragment, 1; "handle," 1.
Forms represented: Shallow tray, 1; unknown, 1.
Work direction: Right to left, 2.

Technique and Comments: Two whole rods arranged vertically (one above the other) are sewn with stitches that wrap rather than pierce the rods. In the tray fragment, a decorticated rod is sewn with non-interlocking stitches accidentally split on both surfaces; in the "handle," a figure-8 stitch is employed. There is a small gap between the stitches exposing the foundation on the "handle" fragment. Work surface is concave on the tray fragment and both specimens are rigid. The "handle" is finished with a self rim on both margins. Both specimens are undecorated, unmended and unpitched. The tray fragment is watertight, owing to the tightness of the weave. Splices in the "handle" have "moving" ends and "fag" ends bound under. No wear patterns are discernible on either specimen. As is the case with the so-called "handle" in Type VII, there is no conclusive evidence that the specimen necessarily served that function.

Measurements: Range in diameter of coils, 4.5–6 mm; mean diameter of coils, 5.16 mm; range in width of stitches, 2–3 mm; mean width of stitches, 2.62 mm; range in gap between stitches (one specimen only), 0–15 mm; mean gap between stitches (one specimen only), 0.5



Figure 126. Type XI wall fragment of shallow tray; close coiling, two rod stacked foundation, non-interlocking stitch; non-work surface.

mm; range in coils per centimeter, 1.5–2; mean coils per centimeter, 1.75; range in stitches per centimeter, 3.5–4; mean stitches per centimeter, 3.75.

Type XII: Close Coiling, Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch (Fig. 127)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Shallow tray.
Work direction: Left to right.

Technique and Comments: A single whole rod and a retted fiber bundle are sewn with non-interlocking stitches, which pierce the bundle. Some accidental splitting of the stitches occurs on the non-work surface. There is no gap between the stitches. Work surface is concave. The specimen is semiflexible, undecorated, unmended and unpitched, but is naturally watertight owing to the tightness of the weave. Splice type is not discernible. Heavy wear occurs on both surfaces.

Measurements: Diameter of coils, 3.75 mm; width of stitches, 3 mm; gap between stitches,

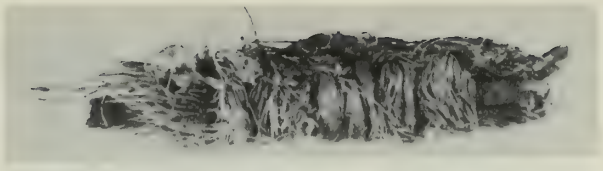


Figure 127. Type XII wall fragment of shallow tray; close coiling, whole rod and bundle stacked foundation, non-interlocking stitch; non-work surface.

0; coils per centimeter, 1.25; stitches per centimeter, 3.

Type XIII: Close Coiling, Two-Rod and Bundle Stacked Foundation, Non-Interlocking Stitch
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Steep-sided bowl.
Work direction: Right to left.

Technique and Comments: Two decorticated whole rods and a retted fiber bundle are sewn with non-interlocking stitches, which pierce the bundle. Some accidental splitting of the stitches occurs on the work surface. There is a gap between the stitches exposing the foundation. Work surface is convex. The specimen is rigid, undecorated, unmended, unpitched and not naturally watertight. Splice type is not discernible. Heavy wear is present on the convex surface.

Measurements: Diameter of coils, 6.19 mm; width of stitches, 2.2 mm; gap between stitches, 1.93 mm; coils per centimeter, 1; stitches per centimeter, 4.5.

Type XIV: Close Coiling, Two-Rod and Welt Bunched Foundation, Non-Interlocking Stitch (Fig. 128)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Shallow tray.
Work direction: Right to left.

Technique and Comments: Two whole decorticated rods arranged horizontally and surmounted by a flat welt are sewn with non-interlocking stitches, which wrap rather than pierce the welt. Some accidental splitting of the stitches occurs on both surfaces. There is no gap between the stitches. Work surface is concave. The specimen is rigid, undecorated, unmended, unpitched and not naturally watertight. Splices and fag and moving ends are bound under. Wear



Figure 128. Type XIV wall fragments of shallow tray; close coiling, two rod and welt bunched foundation, non-interlocking stitch; work surface.



Figure 129. Type XV wall fragment of shallow parching tray; close coiling, three rod bunched foundation, non-interlocking stitch; work surface.

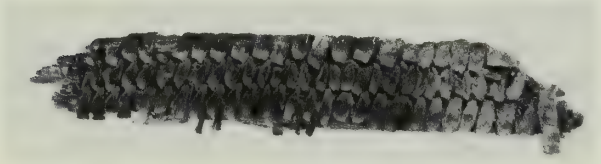


Figure 130. Type XVI rim fragment of shallow bowl; close coiling, two rod and bundle bunched foundation, inter-locking stitch; note self rim; non-work surface.

patterns are not discernible on this highly fragmentary specimen.

Measurements: Diameter of coils, 5.5 mm; width of stitches, 1.75 mm; gap between stitches, 0; coils per centimeter, 2; stitches per centimeter, 5.

Type XV: Close Coiling, Three-Rod Bunched Foundation, Non-Interlocking Stitch (Fig. 129)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Shallow tray.
Work direction: Right to left.

Technique and Comments: Two whole decorticated rods arranged horizontally and surmounted by a third whole decorticated rod are sewn with non-interlocking stitches. The third, or apex, rod is much smaller in diameter than the other two and is wrapped, rather than pierced, by the stitches. Some accidental splitting of the stitches occurs on both surfaces. There is a gap between the stitches exposing the foundation. Work surface is concave. The specimen is rigid, undecorated, unmended, and unpitched, but is naturally watertight owing to the tightness of the weave. Splices have fag and moving ends clipped short. Heavy wear is present on the convex surface, while the concave surface exhibits extensive charring, suggesting that the specimen is part of a parching tray.

Measurements: Diameter of coils, 5.75 mm; width of stitches, 1.75 mm; gap between stitches, 1 mm; coils per centimeter, 2; stitches per centimeter, 4.

Type XVI: Close Coiling, Two-Rod and Bundle Bunched Foundation, Interlocking Stitch (Fig. 130)
Number of specimens: 2.
Type of specimens: Rim fragment, 1; base fragment, 1.
Forms represented: Bowl, 1; unknown, 1.
Work direction: Right to left, 2.

Technique and Comments: Two whole rods arranged horizontally and surmounted by a retted fiber bundle are sewn with interlocking stitches, which wrap rather than pierce the bundle. In one specimen, the cortex is left on the rods; in the other, rods are decorticated. One specimen exhibits accidental splitting of the stitches on both surfaces, while the other shows accidental splitting on the non-work surface only. There is no gap between the stitches. Work surface is convex on one specimen and undetectable on the other. The base fragment has a continuous coil center and its rim is a variation of the self type. A row of wrapping stitches has been added to the rim to fill the interstices of the terminal circuit of construction stitches. Both specimens are rigid, undecorated, unmended and unpitched, although one is naturally watertight owing to the tightness of the weave. Splices have fag and moving ends bound under. There are no wear patterns.

Measurements: Range in diameter of coils,

4.5–5 mm; mean diameter of coils, 4.75 mm; range in width of stitches, 2–2.5 mm; mean width of stitches, 2.25 mm; range of gap between stitches, 0; range in coils per centimeter, 2.5–4; mean coils per centimeter, 3.25; range in stitches per centimeter, 4–4.5; mean stitches per centimeter, 4.25.

Type XVII: Close Coiling, Two-Rod and Bundle Bunched Foundation, Non-Interlocking Stitch (Fig. 131)

Number of specimens: 36.

Type of specimens: Complete, 3; wall fragments, 25; rim fragments, 4; base fragments, 4.

Forms represented: Shallow trays, 22; steep-sided bowls, 8; bifurcated base ceremonial baskets, 2; carrying basket, 1; unknown, 3.

Work direction: Right to left, 32; left to right, 1; unknown 3.

Technique and Comments: Two whole rods arranged horizontally and surmounted by a retted fiber bundle are sewn with non-interlocking stitches, which pierce the bundles. In one example of this type, the stitches which pierce the bundles also pierce the foundation rods. In eight specimens, the cortex is left on the rods; in the remainder, rods are decorticated. Twenty-two specimens exhibit accidental splitting of the stitches on both surfaces, and there are three examples each of accidental splitting on the work or non-work surface only. There is a gap between the stitches exposing the foundation on eight specimens. Work surface is concave on 22 specimens and convex on eight; the work surface is not detectable on the remaining specimens. All examples of this type are rigid. The fragmentary specimens include four continuous coil centers, two of which have apertures; three self rims, and one false braid rim in a 2/2 interval. None of the fragments is pitched, although 25 are naturally watertight owing to the tightness of the weave. One specimen has been mended by replacing the fiber bundle with a complete circuit of Type XVII coiling taken from another basket. The alien coil is much smaller in diameter than the coil onto which it has been grafted and serves the same function as a normal bundle. The work surface of the alien coil is the reverse of that of the specimen to which it has been spliced. One wall fragment and one large rim fragment of two separate carrying baskets are decorated with geometric designs (Fig. 132, 133) produced by inserting rows of darker stitches at varying intervals. The decorative technique is identical to that described and figured by Morris and Burgh (1942: Fig. 10a). The decorated rim fragment was found in association with an approximately 20 cm length of 2-ply S-spun Z-twist cordate (diameter of cordage, 3 mm; twists per centimeter, 3) and four pieces of worked wood. Splices of the fragments include 10 examples of fag and moving ends bound under; four of fag and moving ends clipped short, and one each of fag ends clipped short and moving ends bound under, fag ends bound under and moving ends clipped short, and fag ends clipped short with moving ends clipped and concealed under stitches. In one specimen, the moving end is clipped short and concealed under stitches, while the fag end is obscured by wear. In another, the moving end is bound under and the fag ends are obliterated by use. Nine frag-

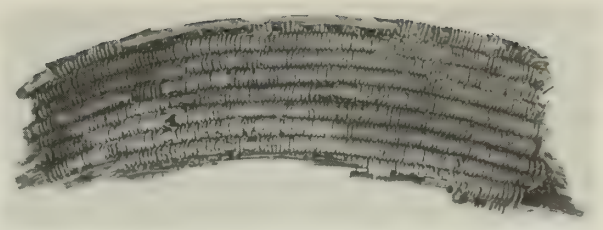


Figure 131. Type XVII wall fragment of shallow tray; close coiling, two rod and bundle bunched foundation, non-interlocking stitch; note self rim; non-work surface.



Figure 132. Geometric design from carrying basket rim fragment.

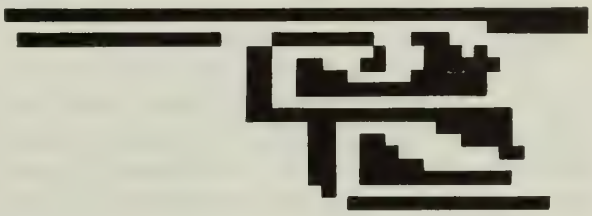


Figure 133. Geometric design from carrying basket wall fragment.

ments exhibit heavy wear on both surfaces; five have wear on the work surface only; one has wear on the work surface and use sheen on the non-work surface; and one has use sheen on the work surface only. Three fragments are heavily charred on the work surface, indicating that they are portions of parching trays. The complete or nearly complete specimens of Type XVII coiling are individually described below:

Container 1 (Fig. 134):

This specimen is a flat-bottomed bowl with nearly vertical walls. The rim is of the self type; the center is absent. The specimen is undecorated, unmended, unpitched and naturally watertight. Splices have fag ends clipped short and moving ends bound under. There is heavy wear on the non-work (interior) surface of this specimen and moderate to heavy wear on the work (exterior) surface.

Container 2 (Fig. 135):

This specimen is a bifurcated base ceremonial basket and is virtually identical in configuration to the Class B coiled forms described and figured by Morris and Burgh (1942: 27–28, Fig. 11). The specimen is oval in cross section, with a slightly excurvate rim and incurvate base. The final rim circuit and the original base and center are missing. Two burden ties of 2-ply S-twisted sinew (diameter 1.7 mm) are located on the rear wall of the specimen approximately 6 cm below the extant rim. These ties encircle five circuits of foundation and are spaced approximately 202 cm apart. They are attached to the basket wall with granny knots. One of the burden ties is loosely bound with several circuits of 2-ply S-spun Z-twist *Yucca* sp. fiber cordage (diameter 2.1 mm) secured with a square knot. At some point in its history, the original (and presumably well worn) base and center of this container were replaced with eight spliced coils clearly produced by a hand other than that of the original manufacturer. Splicing is done with simple running stitches; these added coils are open and do not seal the base of the basket. The basal aperture apparently was closed by stitching several lengths of cordage across the opening. One of the pieces of cordage is 3-ply S-spun Z-twist (diameter 3 mm) and is "rat-tailed," while the other is 2-ply S-spun Z-twist (diameter 2 mm). Both are secured to opposing margins of the base with overhand knots. After the base of the specimen was

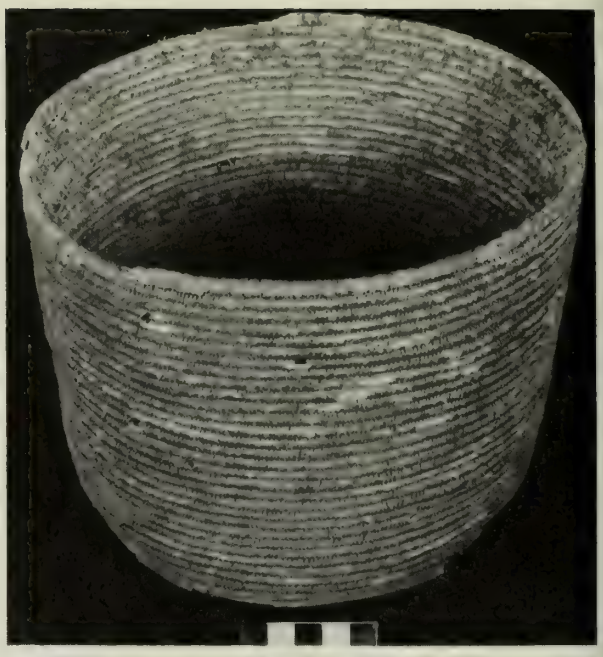
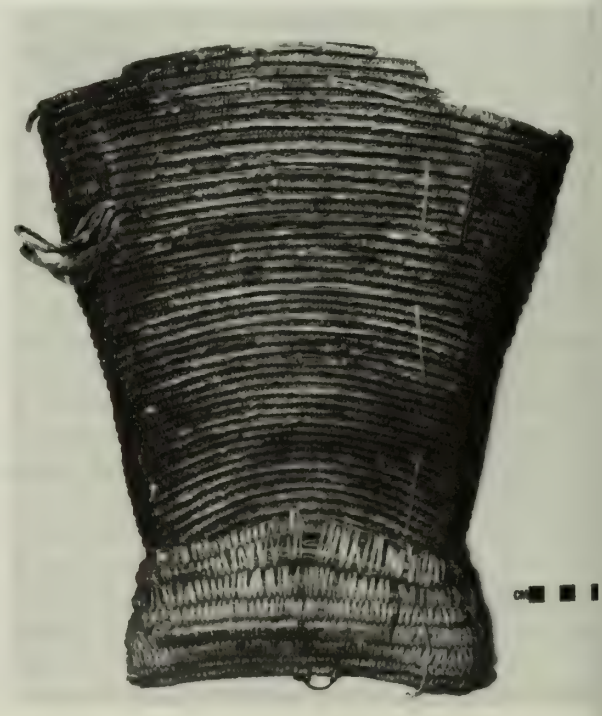


Figure 134. Type XVII complete steep-sided bowl minus final rim circuit. Work surface is convex.

Figure 135. Type XXVII complete bifurcated base ceremonial basket; note spliced base, burden ties and cotton running stitches; work surface.

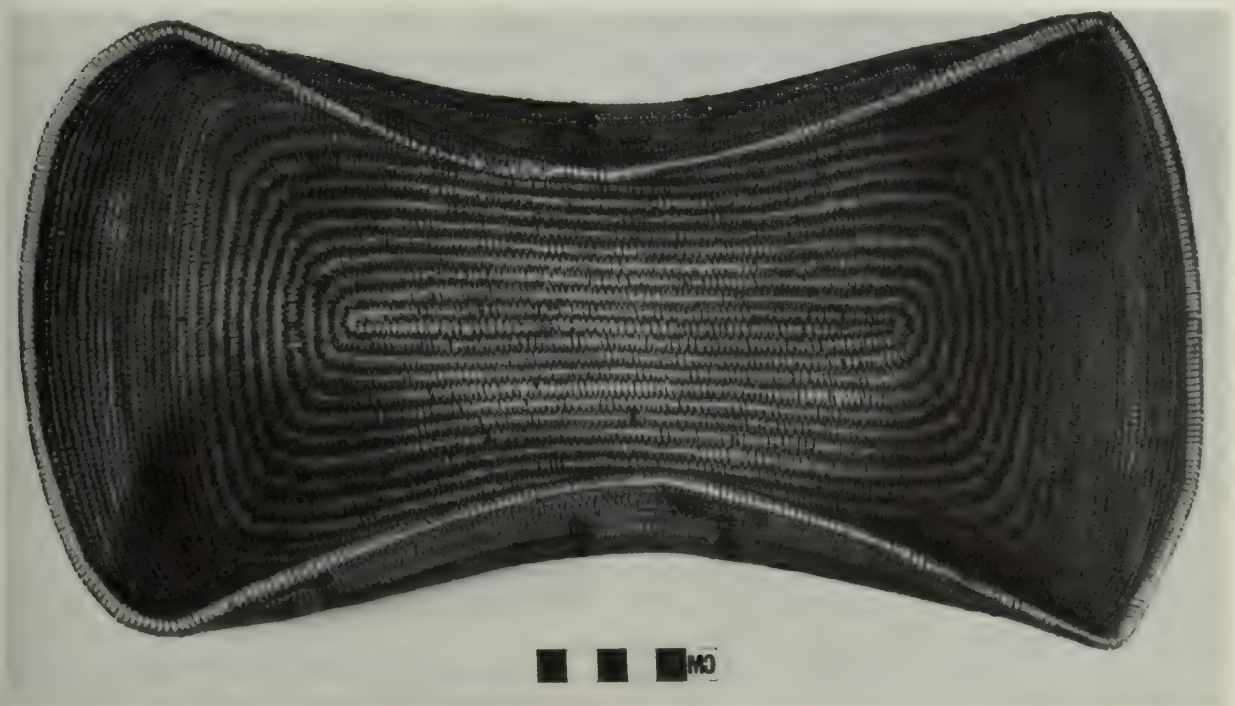


replaced, a length of 5-ply S-spun Z-twist cotton cordage was attached with a running stitch to one lateral margin of the basket. This stitch runs the length of the basket. Its function is unknown. The container is undecorated, unpitched and naturally watertight. Splices of both the original and added coils have both fag and moving ends bound under. There is heavy wear on the outer surface of the basket and light wear on the interior.

Container 3 (Fig. 136):

This hourglass-shaped, flat-bottomed tray is not only the finest complete specimen of coiling from Antelope House, but is also the finest representative of its configuration ever recovered from any archeological site in the Southwest. The specimen is basically rectangular in plan, with intentionally incurvate lateral walls (long margins) and slightly excurvate terminal walls (short margins). Method of starting is a flattened continuous coil. After the first five circuits of the base, the coils gradually assume the hourglass plan of the finished specimen, leaving no doubt that this highly unusual configuration is intentional. The rim for most of the final circuit is of the self type, with the last 61.5 mm done in a 1/1 false braid. The specimen is unmended, unpitched and naturally watertight. Splices have fag ends clipped short and moving ends bound under. The specimen is decorated with a series of six "geometricized" quadrupedal animal figures. There are two figures on each of the long margins of the basket and one on each "end." In plan, all of the figures are quite similar, with elongate torsos, compressed necks, blocked heads, stubby "erect" tails and short legs (Fig. 137, 138). Spacing is more or less uniform, but the exact dimensions of the figures vary slightly. All of the figures are oriented with their heads to the viewer's right. The designs originally were inserted into the basket wall using the technique described above for fragments of this type. On the outer surface of the basket, however, the designs also were painted over in three colors: black, aqua and red. Bodies and heads always are red and are outlined on the dorsal surface in the opposite color. Each figure has two aqua and two black legs. Although the dorsal and ventral outlines always are a different color in the same figure, the sequence of colors is not consistent around the basket. The aqua-backed forms are found on each short wall or end of the basket,

Figure 136. Type XVII complete hour-glass tray; note flattened continuous coil center and 2/2 false termination of self rim; work surface.



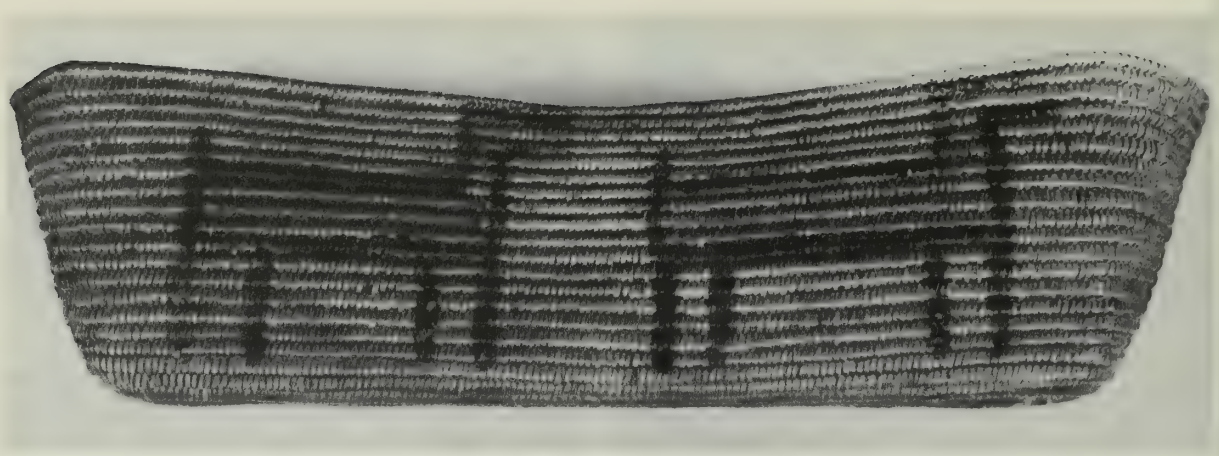


Figure 137. Type XVII complete hour-glass tray; note "geometricized" quadrupeds; non-work surface.



Figure 138. "Geometricized" quadruped design from complete hour-glass tray.

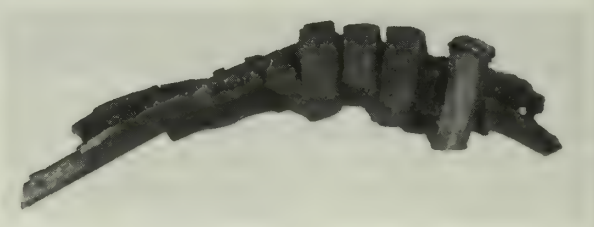


Figure 139. Type XVIII wall fragment; five rod bunched foundation, non-interlocking stitch; work surface undetectable.

while each long wall has both a black and an aqua-backed form. Whatever the color of the dorsal or ventral outline, each figure has the same sequence of leg colors. When viewed from the right, the first and third legs are aqua and the second and fourth legs are black. Though the designs are badly faded on the interior and moderately faded on the exterior, this container exhibits no use wear on any surface. The contents of this unique basket (see Chapter 19) strongly suggest that it was produced for some non-utilitarian function.

Measurements (all specimens): Range in diameter of coils, 4–13 mm; mean diameter of coils, 6.6 mm; range in width of stitches, 0.5–3.75 mm; mean width of stitches, 1.75 mm; range in gap between stitches, 0–2.4 mm; mean gap between stitches, 1.75 mm; range in coils per centimeter, 1–3; mean coils per centimeter, 1.8; range in stitches per centimeter, 3–10; mean stitches per centimeter, 5.05.

Measurements (complete specimens): Container 1—maximum diameter of rim, 205 mm; maximum diameter of base, 190 mm; maximum depth, 160 mm. Container 2—maximum length (center of excurvate rim to center of bifurcated base), 340 mm; maximum width of rim, 300 cm; minimum width of rim, 190 mm; maximum width of base, 220 mm; minimum width of base, 50 mm. Container 3—maximum length, 380.5 mm; maximum width, 200 mm; minimum width, 80 mm; maximum depth, 855 mm.

Type XVIII: Close Coiling, Five-Rod Bunched Foundation, Non-Interlocking Stitch (Fig. 139)
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Unknown.
Work direction: Right to left.

Technique and Comments: A bundle of five whole rods with cortex is sewn with non-inter-

locking stitches, which wrap rather than pierce the bundle. Work surface is not detectable. The specimen is rigid, undecorated, unmended, unpitched and not naturally watertight. Because the specimen is disintegrating, splice type and wear patterns are not discernible.

Measurements: Diameter of coils, 8 mm; width of stitches, 3 mm; gap between stitches, 0; coils per centimeter, 1.5; stitches per centimeter, 1.5.

Type XIX: Open Coiling, One-Rod Foundation, Intricate Stitch
Number of specimens: 1.
Type of specimen: Wall fragment.
Form represented: Unknown.
Work direction: Right to left.

Technique and Comments. This highly fragmentary specimen is the only piece of open coiling recovered from Antelope House. A single whole decorticated rod is sewn with intricate interlocking stitches, which wrap rather than pierce the rod. This stitch variety is identical in all particulars to that figured and described by Morris and Burgh (1941: 17, Fig. 30 a,b) as Spaced Coiling, 1. Work surface is not detectable. The specimen is rigid, undecorated and unmended.

Measurements: Diameter of coils, 3 mm; width of stitches, 2 mm; coils per centimeter, 1; stitches per centimeter, 5.

Plaiting

The 466 pieces of plaited basketry recovered from Antelope House are assigned to four structural types, which are described below by numerical prefix. The descriptive format for this subclass is modified, in that all specimens without selvage are discussed first, followed by specimens with selvage. Specimens with selvage are described and/or discussed by form class (e.g. ring baskets, matting, pot rests, etc.) and by selvage type. Table 138 presents the distribution of plaited basketry by type, raw materials, period and provenience.

Type XX (without selvage): Simple Plaiting, 1/1 Interval
Number of specimens: 2.
Type of specimens: Fragments.
Forms represented: Matting, 1; bag, 1.

Technique and Comments: Single elements pass over each other in a 1/1 interval. No shifts are present. Both specimens are undecorated, unmended, unpitched and not watertight. Both sides of the matting fragment exhibit light to moderate wear.

Measurements: Range in diameter of plaiting elements, 4–13 mm; mean diameter of plaiting elements, 6.25 mm; angle of crossing of plaiting elements, 90°.

Type XXI (without selvage): Twill Plaiting, 2/2 Interval (Fig. 140)
Number of specimens: 98.
Type of specimens: Fragments.
Number of artifacts represented: 60 (minimum).
Forms represented: Matting, 69; ring baskets, 24; pot rests, 2; rigid containers, 2; bag, 1.

Technique and Comments: Single elements pass over each other in a 2/2 interval. Shifts are present in three of the matting fragments and 12 of the ring basket fragments. In some cases, notably ring basket centers, several different shifts are present in the same specimen and clearly constitute portions of geometric decorative patterns. Matting shifts include two examples of 2/6/2 intervals and one each of 2/3/2, 2/3/1/3/2, 2/3/4/2 and 2/3/1/2 intervals. Ring basket shifts include nine examples of 2/1/2 intervals, six of 2/3/2 intervals and one each of 2/1/1/1/1/2 and 2/3/3/2 intervals. Recognizable designs in the ring basket fragments include eight "plain meanders" (see Morris and Burgh 1942: Fig. 10, f, g, i, j), one of which employs alternating sets of light and dark elements. The rigid container and pot rest fragments lack shifts of any sort. The bag fragment is a partially finished elongate pouch with several irregular 2/1/2 shifts. The unplaited elements are bound with eight circuits of single-ply, untwisted *Yucca* sp. cordage (diameter 1.9 mm) secured by a double half-hitch and a running bowline. The bag is initiated by plaiting a small, depressed, circular center and folding the elements at a 90° angle away from the center. All specimens of this type (i.e., without selvage) are reinforced with single-ply, unspun fiber sewn in a running stitch. All specimens are unpitched; however, the two rigid container fragments are very tightly woven and are naturally watertight. Fifty-six of the mat fragments exhibit moderate to heavy

Table 138. Distribution of plaited basketry by type, raw material, period and provenience—Continued

Key

The first Roman numeral indicates plaiting type; the set of letters designates raw materials; the Arabic numeral represents number of specimens.

S = *Scirpus* sp.
Sa = *Salix* sp.
T = *Typha* sp.
Ya = *Yucca angustissima*
Yb = *Yucca baccata*
Z = *Zea mays*

	South Area								
	South Area	*South Plaza*	*South Plaza Floor 1*	*South Plaza Burial 5*	*Kiva D*	*Stair 69*	*Room 72*	*Room 77*	*Room 82*
BMIII									
		XXI-Ya-1							
PI									
		XX-S-1	XXI-Ya-1		XXI-Ya-1	XXI-S-1	XX-Yb-1	XXI-Ya-1	
		XXI-S-1			XXI-S-1	XXII-Ya-1	XX-S-1		
PII									
		XX-Ya-1			XXI-Ya-1				XXI-S-2
		XXI-S-5							
		XXI-Ya-2							
		XXI-Yb-1							
EPIII		XXII-Ya-1							
		XX-Ya-1						XXI-S-1	
		XXI-Ya-1							
		XXII-S-1							
MPIII									
		XX-Ya-3	XXI-S-8	XXI-S-1					
		XX-Yb-1	XXI-Ya-2	XXI-Ya-1					
		XXI-S-5	XXI-Yb-4	XXI-YB-1					
		XXI-Ya-2							
LPIII									
		XX-Ya-1							
		XX-Yb-1							
		XXI-S-1							
Navajo		XXII-S-1							
Historic	XXI-Yb-1								
		XX-Ya-1							
		XXI-S-3							
		XXI-Yb-1							
		XXII-Ya-1							
		XXII-S-1							
Unknown		XXIII-S-1							
TOTALS	1	39	15	3	3	2	2	2	2

Room 84	*South Room Block South Room Block*	*Tower Corridor*	*Tower Corridor Floor 1*	*Tower Corridor Floor 2*	*Tower Corridor Floor 3*	*Tower Corridor Floor 4*	*Room 1*	*Room 1 Floor 1*	*Room 1 Floor 2*
XXI-S-1		XXI-S-2				XX-Yb-1	XXI-S-3		
		XX-Yb-2 XXI-Ya-1				XXI-S-2	XXI-Ya-1 XXI-S-3		
		XX-Yb-1 XXI-S-13 XXI-Yb-1	XXI-S-2	XXI-S-1	XX-Yb-1 XXI-S-1 XXI-Ya-1	XXI-S-2	XX-S-2 XX-Ya-2 XX-Yb-1 XXI-S-31 XXI-Ya-2 XXI-Yb-3	XXI-S-1	XXI-S-1
	XX-Yb-1	XXI-Ya-1 XXI-S-2							
1	1	23	2	1	3	5	48	1	1

continued

Table 138. Distribution of plaited basketry by type, raw material, period and provenience—Continued

Key

The first Roman numeral indicates plaiting type; the set of letters designates raw materials; the Arabic numeral represents number of specimens.

S = *Scirpus* sp.
Sa = *Salix* sp.
T = *Typha* sp.
Ya = *Yucca angustissima*
Yb = *Yucca baccata*
Z = *Zea mays*

	Room 2	*Room 9*	*Room 9 Floor 1*	*Room 21*	*Room 21 Floor 2*	*Room 21 Floor 3*	*Room 22*	*Room 22 Floor 1*	*Room 22 Floor 2*	*Room 23*
BMIII										
PI				XXI-S-3 XXI-Ya-4						
PII	XX-Yb-1			XXII-S-1 XXII-Yb-1	XXII-S-2					
EPIII				XX-Sa-1 XXI-S-8 XXI-Ya-8 XXI-Yb-2		XXI-Ya-1	XX-Yb-1 XXI-S-1 XXI-Ya-2	XX-Yb-1	XX-Ya-1	
MPIII	XXI-S-1 XXI-Ya-1 XXII-S-1	XXI-Ya-1	XXI-S-2	XXII-S-1 XXI-S-2 XXII-S-1 XXII-YaYb-1	XXI-S-11 XXI-Ya-2 XXI-T-3 XXII-S-1 XXII-Yb-1					XXI-S-2 XXI-Ya-1
LPIII							XXI-S-1			XXII-Ya-1
Navajo										
Historic	XXI-S-4									
Unknown										
TOTALS	8	1	2	33	20	1	5	1	1	4

								Central Room Block	
Room 29	*Room 29 Floor 2*	*Room 29 Floor 3*	*Room 29 Floor 5*	*Room 30*	*Room 30 Floor 1*	*Room 30 Cache Pit 32b*	*Kiva B*	*Kiva B Floor 1*	*Kiva B Annex*
XXI-S-1									
XX-Ya-1 XXI-S-1 XXII-S-2									
XX-Ya-2 XXI-S-3 XXI-Yb-1 XXII-Ya-1			XXI-S-1				XX-Yb-1		
XXI-S-5 XXI-Yb-1 XXI-Ya-2	XX-Ya-2 XXI-S-1 XXI-Ya-3			XX-Z-1 XX-Ya-1 XXII-S-1		XXI-Ya-1			
XXI-S-8 XXI-Ya-9 XXI-Yb-1 XXII-S-1	XXI-S-9 XXI-Ya-2	XXI-S-3 XXI-Ya-5 XXII-S-3		XXI-S-2	XX-Ya-4 XXI-S-2 XXI-Ya-4 XXII-S-1 XXII-Yb-1		XX-Ya-1 XX-Yb-3 XXI-S-7 XXI-Ya-1 XXI-Yb-2	XXI-S-1	XX-Ya-1 XXI-S-5 XXI-Ya-2
									XXI-Ya-1
							XX-Ya-1		XX-Ya-1 XXI-Yb-1
39	17	11	1	5	12	1	16	1	11

continued

Table 138. Distribution of plaited basketry by type, raw material, period and provenience—Continued

Key

The first Roman numeral indicates plaiting type; the set of letters designates raw materials; the Arabic numeral represents number of specimens.

S = *Scirpus* sp.
Sa = *Salix* sp.
T = *Typha* sp.
Ya = *Yucca angustissima*
Yb = *Yucca baccata*
Z = *Zea mays*

Kiva B Annex Floor 1	*Kiva C*	*Room 27*	*Room 36 Floor 1*	*Room 36 Floor 5*	*Room 40*	*Room 40 Floor 1*	*Room 42*	*Room 43*	*Room 44*
BMIII									
PI									
PII									
EPIII									
MPIII									
XXI-S-1	XXI-S-1 XXII-Ya-1	XX-Ya-1 XX-Yb-1 XXI-S-1 XXI-Ya-1	XXI-S-1	XXI-S-3	XX-Yb-2 XXI-S-5 XXI-Ya-2	XX-Ya-1 XXI-S-2	XXI-Ya-1 XXI-S-2	XX-Yb-2 XXI-S-1	XXI-S-3 XXI-Ya-2 XXII-S-2
LPIII									
Navajo									
Historic									
		XXI-S-1						XXI-S-1	XXI-S-1
Unknown									
1	2	5	1	3	9	3	3	4	8

TOTALS

Room 48	*Room 52*	*Room 53*	*Room 54*	*Room 54 Floor 1*	*Structure 81*	*North Room Block North Room Block*	*Room 5*	*Room 6*	*Room 7*
							XX-Yb-1		
							XXI-S-3 XXI-Ya-1		XXI-Ya-1
							XXI-S-1		
								XXI-S-2	
XXI-S-4 XXII-S-2	XXI-S-1	XXI-S-1		XX-Ya-1 XXI-S-1	XXI-S-1		XXI-S-2 XXI-Ya-1		XXI-S-1
XXI-Yb-1			XXI-S-1			XX-Ya-1	XXI-Yb-1 XXI-S-1 XXI-Ya-1	XXI-S-1	
7	1	1	1	2	1	1	12	3	2

continued

Table 138. Distribution of plaited basketry by type, raw material, period and provenience—Continued

Key

The first Roman numeral indicates plaiting type; the set of letters designates raw materials; the Arabic numeral represents number of specimens.

S = *Scirpus* sp.
Sa = *Salix* sp.
T = *Typha* sp.
Ya = *Yucca angustissima*
Yb = *Yucca baccata*
Z = *Zea mays*

	Room 16	*Room 18*	*Room 18 Floor 2*	*Room 19*	*Room 31*	*Room 35 Floor 1*	*Room 38 Floor 2*	*Room 41*	*Room 41 Floor 2*	*Room 46*	*Room 46 Burial 8*
BMIII				XXI-S-1							
PI											
PII											
EPIII											
MPIII		XXI-S-3 XXI-Ya-1		XXI-Yb-1	XXI-S-3		XXI-S-1	XXI-S-1 XXI-Yb-1	XXI-S-1 XXI-Ya-1	XXI-S-2 XXI-Ya-1	XXI-S-1
LPIII				XXI-S-1 XXI-Ya-1							
Navajo											
Historic	XXI-S-2	XXI-Yb-1	XXI-S-1			XX-Yb-1					
Unknown											
TOTALS	2	5	1	4	3	1	1	2	2	3	1

Room 47	*Room 47 Floor 1*	*Room 49 Floor 1*	*Room 51*	*Room 51 Floor 2*	*North Terrace*	*North Area*	Totals
							2
							7
							22
							34
							60
XXI-S-6 XXI-Ya-2 XXI-Yb-1	XXI-Ya-1	XXI-S-1	XXI-S-1		XX-Ya-2 XXI-S-5 XXII-Ya-1	XX-Yb-1 XXI-S-1	293
							8
							2
				XXI-S-1	XXI-S-1 XXIII-Ya-1	XXI-S-1	
							38
9	1	1	1	1	10	3	466



Figure 140. Type XXI (without selvage) unfinished bag; twill plaiting, 2/2 interval.

wear on both surfaces; two are worn on one surface only. Nine specimens, well worn on both sides, are also charred. One specimen has a dense, reddish, waxy substance of unknown composition adhering to one surface. Another, apparently a portion of a burial mat, has a segment of balanced plain weave cloth (single-ply Z-spun *Yucca* sp. warps and wefts; 10 warps and wefts per centimeter) adhering to one surface, along with bits of human hair and skin. Twelve of the ring basket fragments exhibit moderate to heavy wear on both surfaces; four are worn on one surface only. The 12 specimens worn on both surfaces also are charred. One ring basket specimen has a granny knot made of single-ply, untwisted *Scirpus* sp. fiber affixed to one edge. "Foreign" matter adhering to the surface of one or more ring basket fragments includes human coprolites, hair, seeds, feathers and insect exoskeletons. One fragment is markedly curved, with two circular depressions, the purpose of which is unknown. One pot rest fragment is badly fragmented through heavy wear and one rigid container fragment exhibits light wear on one side only. The bag fragment has no wear patterns.

Measurements (matting):Range in diameter of plaiting elements, 3.3–12.8 mm; mean diameter of plaiting elements, 5.89 mm; range in angle of crossing of plaiting elements, 80°–100°; mean angle of crossing of plaiting elements, 90°.

Measurements (ring baskets): Range in diameter of plaiting elements, 2–7.8 mm; mean diameter of plaiting elements, 4.21 mm; range in angle of crossing of plaiting elements, 80°–100°; mean angle of crossing of plaiting elements, 90°.

Measurements (pot rests):Range in diameter of plaiting elements, 3–6.33 mm; mean diameter of plaiting elements, 4.38 mm; mean angle of crossing of plaiting elements, 90°.

Measurements (rigid containers): Range in diameter of plaiting elements, 3.4–6.1 mm; mean diameter of plaiting elements, 4.77 mm; mean angle of crossing of plaiting elements, 90°.

Measurements (bag): Range in diameter of plaiting elements, 3–7 mm; mean diameter of plaiting elements, 5 mm; mean angle of crossing of plaiting elements, 70°.

Type XXII (without selvage): Twill Plaiting, 3/3 Interval

Number of specimens: 12.
Type of specimens: Fragments.
Number of artifacts represented: 9 (minimum).
Forms represented: Matting, 9; ring baskets, 3.

Technique and Comments: Single and, in one case, double elements pass over each other in a 3/3 interval. In the specimen with paired elements, only two of the extant sets are doubled.

Interestingly, in both sets, the doubled elements are two different species of *Yucca*. A single 3/4/5/3 shift is present in one matting fragment, while a ring basket center has a plain concentric diamond pattern (cf. Morris and Burgh 1942: Fig. 10c) produced by alternating the standard 3/3 interval with 3/4/5/3, 3/5/4/3, 3/8/3 and 3/2/1/3/5/3 shifts. All specimens are unmended, unpitched and not naturally watertight. All of the matting fragments exhibit moderate to heavy wear on both surfaces; two are charred and one is stained on one surface. Two of the ring basket fragments are heavily worn on both surfaces and one of them is charred. Foreign matter adhering to the surface of one or more matting or ring basket fragments includes human coprolites, seeds, feathers and insect exoskeletons.

Measurements (matting): Range in diameter of plaiting elements, 2.5–7.1 mm; mean diameter of plaiting elements, 4.55 mm; mean angle of crossing of plaiting elements, 90°.

Measurements (ring baskets): Range in diameter of plaiting elements, 3–6 mm; mean diameter of plaiting elements, 4.5 mm; range in angle of crossing of plaiting elements, 90°–115°; mean angle of crossing of plaiting elements, 101.66°.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval
Form: Matting.
Number of specimens: 11.
Type of specimens: Fragments.
Number of individual mats represented: 8 (minimum).

Technique and Comments: Single and, in one case, double elements pass over each other in a 1/1 interval. Shifts include one example each of 2/1/2 and 2/1/1/2 intervals. The selvage treatment has terminal elements folded back at a 90° angle and replaited into the body of the mat. All specimens are undecorated, unpitched and not naturally watertight. One specimen is mended or reinforced with a strip of untwisted *Yucca baccata*, which has been irregularly sewn in a running stitch across the fragment. Six specimens exhibit moderate to heavy wear on both surfaces; one specimen has moderate wear on one surface only. Two specimens are stained on both surfaces and two with wear on both sides also are charred.

Measurements: Range in diameter of plaiting elements, 3–15 mm; mean diameter of plaiting elements, 8.34 mm; angle of crossing of plaiting elements, 87°.

Type XX (90° self selvage): Single Plaiting, 1/1 Interval
Form: Four-element plaited band.
Number of specimens: 20.
Type of specimen: Fragments.
Number of individual bands represented: 20.

Technique and Comments: These and all other plaited bands share the same basic configuration. They are elongate, rectangular items resembling belts in general appearance. "Ends," where present, are squarish with slightly rounded corners. Construction may be initiated either in the center or at one end. The basic manufacturing process is identical to braiding in cordage production, with one notable and singular exception: braided cordage is basically three dimensional, while plaited bands are two dimensional, or flat. The basic selvage technique is the same in all variants of plaited bands. Terminal elements are folded back at a 90° angle and replaited into the body of the band. In some cases, 180° terminal element manipulations are employed at the corners to insure a symmetrical appearance. In this variant, four single, and, in one case, double elements pass over each other in a 1/1 interval. No shifts are present. All specimens are undecorated, unmended, unpitched and not naturally watertight. Eleven specimens exhibit moderate to heavy wear on both surfaces. Of these, three also are charred. One is heavily stained on both surfaces, but otherwise unworn.

Measurements: Range in diameter of plaiting elements, 1–7 mm; mean diameter of plaiting elements, 3.91 mm; range in angle of crossing of plaiting elements, 50°–100°; mean angle of crossing of plaiting elements, 82.10°; range in length, 21–130 mm; mean length, 57.92 mm; range in width, 6–22.5 mm; mean width, 10.30 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 141)
Form: Five-element plaited band.
Number of specimens: 2.
Type of specimens: Fragments.
Number of individual bands represented: 2.



Figure 141. Type XX (90° self selvage) five-element plaited band fragment; simple plaiting, 1/1 interval.



Figure 142. Type XX six-element plaited band fragment.



Figure 143. Type XX eight-element plaited band fragment; note simple overhand knot on loose plaiting elements.

Technique and Comments: Five single elements pass over each other in a 1/1 interval. No shifts are present. Both specimens are undecorated, unmended, unpitched and not naturally watertight. One specimen exhibits moderate wear on both surfaces; the other is stained and charred on one end.

Measurements: Range in diameter of plaiting elements, 2–2.5 mm; mean diameter of plaiting elements, 2.25 mm; range in angle of crossing of plaiting elements, 45°–90°; range in length, 37–80 mm; mean length, 58.5 mm; mean width, 10.4 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 142)
Form: Six-element plaited band.
Number of specimens: 5.
Type of specimens: Fragments.
Number of individual bands represented: 5.

Technique and Comments: Six single elements pass over each other in a 1/1 interval. No shifts are present. All specimens exhibit moderate attrition wear on both surfaces. One specimen is charred on one end and another has a white feather (genus/species unknown) affixed to its surface.

Measurements: Range in diameter of plaiting elements, 2–14 mm; mean diameter of plaiting elements, 5.55 mm; range in angle of crossing of plaiting elements, 80°–90°; mean angle of crossing of plaiting elements, 88°; range in length, 40–194 mm; mean length, 86.8 mm; range in width, 10.7–33.5 mm; mean width, 20.04 mm.

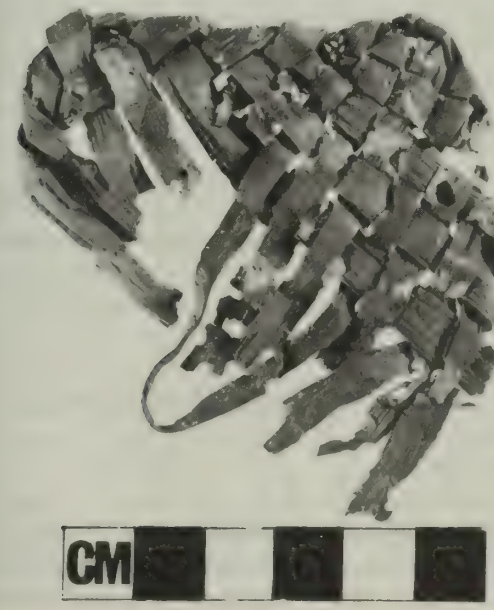
Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 143)
Form: Eight-element plaited band.
Number of specimens: 11.
Type of specimens: Fragments.
Number of individual bands represented: 10.

Technique and Comments: Eight single elements pass over each other in a 1/1 interval. Shifts include one example each of 1/2/1 and 1/2/2/1 intervals. All specimens are undecorated, unmended, unpitched and not naturally watertight. Five specimens exhibit moderate to heavy attrition wear on both surfaces. Of these, four are charred on one end. Three other specimens are stained on one or both surfaces and one spec-



Figure 144. Type XX 10-element plaited band fragment.

Figure 145. Type XX 14-element plaited band fragment.



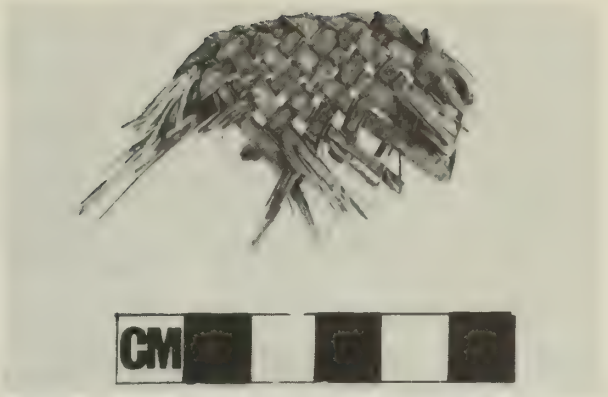


Figure 146. Type XX 18-element plaited band.

imen has feathers (genus/species unknown) adhering to one surface.

Measurements: Range in diameter of plaiting elements, 2–6.8 mm; mean diameter of plaiting elements, 3.51 mm; mean angle of crossing of plaiting elements, 90°; range in length, 32–153 mm; mean length, 82.18 mm; range in width, 10.7–25.5 mm; mean width, 20 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 144)
Form: Ten-element plaited band.
Number of specimens: 5.
Type of specimens: Fragments.
Number of individual bands represented: 5.

Technique and Comments: Ten single elements pass over each other in a 1/1 interval. No shifts are present. All specimens are undecorated, unmended, unpitched and not naturally watertight. Four specimens exhibit moderate to heavy wear on both surfaces. Of these, one is charred.

Measurements: Range in diameter of plaiting elements, 2.2–6 mm; mean diameter of plaiting elements, 3.9 mm; range in angle of crossing of plaiting elements, 80°–100°; mean angle of crossing of plaiting elements, 92°; range in length, 43–238 mm; mean length, 163.2 mm; range in width, 20–43 mm; mean width, 34.24 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 145)
Form: Fourteen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Fourteen single elements pass over each other in a 1/1 interval. No shifts are present. The specimen is undecorated, unmended, unpitched and not naturally watertight. Heavy wear is present on both surfaces.

Measurements: Range in diameter of plaiting elements, 3.7–7 mm; mean diameter of plaiting elements, 5.35 mm; mean angle of crossing of plaiting elements, 90°; length, 73 mm; width, 60.8 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 146)
Form: Eighteen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Eighteen single elements pass over each other in a 1/1 interval. No shifts are present. The specimen is undecorated, unmended, unpitched and not naturally watertight. Heavy attrition wear is present on both surfaces and one side is deeply stained.

Measurements: Mean diameter of plaiting elements, 2.7 mm; mean angle of crossing of plaiting elements, 90°; length, 45 mm; width, 43 mm.

Type XX (90° self selvage): Simple Plaiting, 1/1 Interval (Fig. 147)
Form: Plaited tube.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: This unique specimen is basically an open-ended tube, or cylinder, produced by continuous radial plaiting of 12 single elements in a 1/1 interval. No shifts are present. The end with selvage is notched and has terminal elements folded at a 90° angle and replaited into the body of the tube. The other end of the tube is unfinished. The specimen is undecorated, unmended, unpitched and not naturally watertight. No wear patterns are present.

Measurements: Mean diameter of plaiting elements, 4.9 mm; mean angle of crossing of plaiting elements, 79°; length, 85 mm; maximum interior diameter, 10 mm.

Type XX (180° self selvage): Simple Plaiting, 1/1 Interval
Form: Matting.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 1/1 interval. There are no shifts. The selvage treatment has terminal elements folded back at a 180° angle and replaited into the body of the mat. The specimen is undecorated, unmended, unpitched and not naturally watertight. "Wear" patterns are limited to several dark stains on both surfaces.

Measurements: Mean diameter of plaiting elements, 4.75 mm; mean angle of crossing of plaiting elements, 90°.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval (Fig. 148, 149)
Form: Matting.
Number of specimens: 24.
Type of specimens: Fragments.
Number of individual mats represented: 20 (minimum)

Technique and Comments: Single and, in two cases, double elements pass over each other in a 2/2 interval. No shifts are present. Selvage treatment has terminal elements folded back at a 90° angle and replaited into the body of the mat. In one specimen, alternate elements are folded to opposite surfaces of the mat, producing a double edge. All specimens are undecorated, unmended, unpitched and not naturally watertight. Eleven specimens exhibit moderate to heavy wear on both surfaces; five specimens have moderate to heavy wear on one surface only. Four specimens with wear also are heavily stained and five are charred. Foreign matter adhering to the surface of one or more specimens includes fibers of *Gossypium* sp., feathers (genus/species unknown) and unidentified plant epidermis.

Measurements: Range in diameter of plaiting elements, 1.8–9.2 mm; mean diameter of plaiting elements, 5.3 mm; range in angle of crossing of plaiting elements, 80°–110°; mean angle of crossing of plaiting elements, 91.79°.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Petate.
Number of specimens: 2.
Type of specimens: Fragments.
Number of individual petates represented: 2.

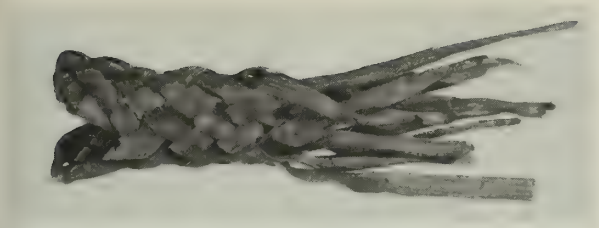


Figure 147. Type XX plaited tube fragment.



Figure 148. Type XXI (90° self selvage) matting fragments; twill plaiting, 2/2 interval.

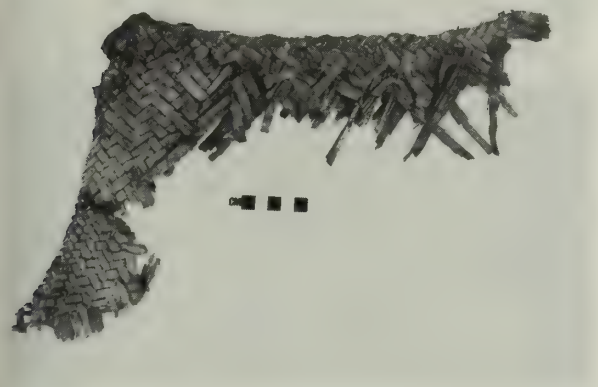


Figure 149. Type XXI (90° self selvage) matting fragment; note 90° selvage on one margin.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No shifts are present. The basic selvage treatment has terminal elements folded back at a 90° angle and replaited into the body of the petate. One hundred and eight degree folds are employed at the corners to insure symmetry. Both specimens are reinforced about 1 to 2 cm below the selvage with a circuit of simple twining. In one specimen, 2-ply unspun S-twist twining engages two plaiting elements at each weft crossing; in the other, 2-ply unspun S-twist twining engages three elements at each weft crossing. Both specimens are undecorated, unmended, unpitched and not naturally watertight. Both specimens exhibit light attrition wear on both surfaces and one is charred.

Measurements: Range in diameter of plaiting elements, 6–10 mm; mean diameter of plaiting elements, 8 mm; mean angle of crossing of plaiting elements, 90°; range in diameter of twining reinforcements, 14–18 mm; mean diameter of twining reinforcements, 1.6 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval (Fig. 150)
Form: Compound plaited baskets.
Number of specimens: 2.
Type of specimens: Complete, 1; fragment, 1.

Technique and Comments: Single elements pass over each other in a 1/1 interval. One specimen has shifts which include examples of 2/3/2, 2/1/3/2, 2/1/1/2 and 2/6/2 intervals. Selvage treatment has terminal elements folded back at a 90° angle and replaited into the body of the basket. Both specimens are more or less circular, flat-bottomed trays with gently sloping walls. The bottoms and walls are produced separately and are joined with a circuit of simple 2-ply unspun S-twist twining that engages two plaiting elements at each weft crossing. The ends of the weft rows are spliced with overhand knots. Both specimens are undecorated, unmended, unpitched and not

Figure 150. Type XXI (90° self selvage) complete compound plaited basket; note method of attachment of walls and base.



naturally watertight. The complete specimen exhibits moderate to heavy attrition wear on the convex (outer) surface and light attrition wear on the concave (inner) surface. The fragmentary specimen has *Gossypium* sp. fibers adhering to the inner surface and feathers (genus/species unknown) adhering to the outer surface.

Measurements (both specimens): Range in diameter of plaiting elements, 3.5–4 mm; mean diameter of plaiting elements, 3.75 mm; mean angle of crossing of plaiting elements, 90°; mean diameter of twining weft rows, 2 mm.

Measurements (complete specimen): Maximum diameter of rim, 85 mm; maximum diameter of base, 65 mm; maximum depth, 16 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Miniature plaited basket.
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: Single elements pass over each other in a 1/1 interval. No shifts are present. Selvage treatment has terminal elements folded at a 90° angle and replaited into the body of the basket. The specimen is oval in plan, with a rounded base and flaring walls. The specimen is rigid, undecorated, unmended, unpitched and not naturally watertight. The interior and exterior surfaces are heavily charred. "*Gossypium* sp.-like" fibers adhere to the exterior surface.

Measurements: Mean diameter of plaiting elements, 3 mm; mean angle of crossing of plaiting elements, 70°; maximum diameter of rim, 33 mm; maximum depth, 17 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
(Fig. 151 through 154)

Technique and Comments: This form group includes flexible and semi-flexible containers of two basic configurations: the globular bag, or pouch, and the elongate, or tubular, bag. Globular bags are represented by one complete and 13 fragmentary specimens; there is a single tubular bag. In all specimens of this form group, single elements pass over each other in a 2/2 interval. Shifts present in the globular bags include examples of 2/1/2, 2/3/2, 2/4/2 and 2/1/3/2 intervals.

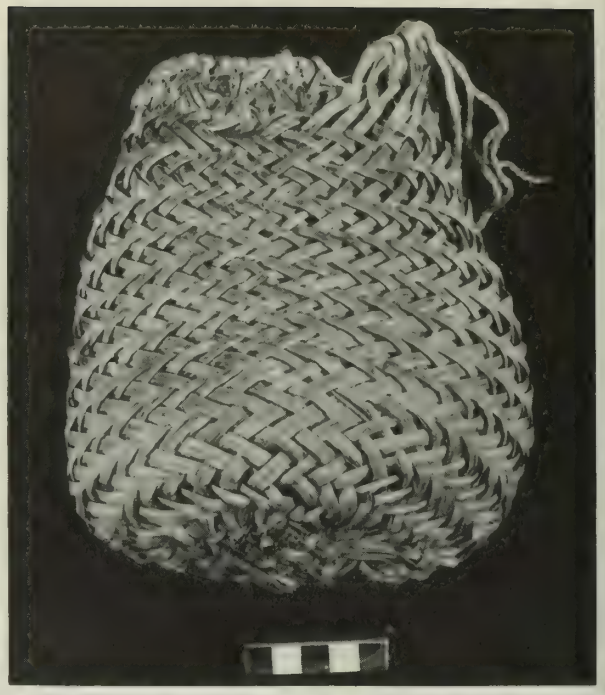


Figure 151. Type XXI (90° self selvage) complete globular bag.



Figure 152. Type XXI (90° self selvage) radial twined center of complete globular bag.

The tubular bag has several 2/3/2 shifts. The complete tubular bag is made of a single whole *Yucca angustissima* plant, the center (or base) consisting of the truncated stalk. The rim selvage has terminal elements folded back at a 90° angle and replaited into the body of the bag. Near the base of the bag, the elements are, of necessity, un-



Figure 153. Type XXI (90° self selvage) globular bag fragment; note cordage reinforcement at mouth and reinforced shoulders.

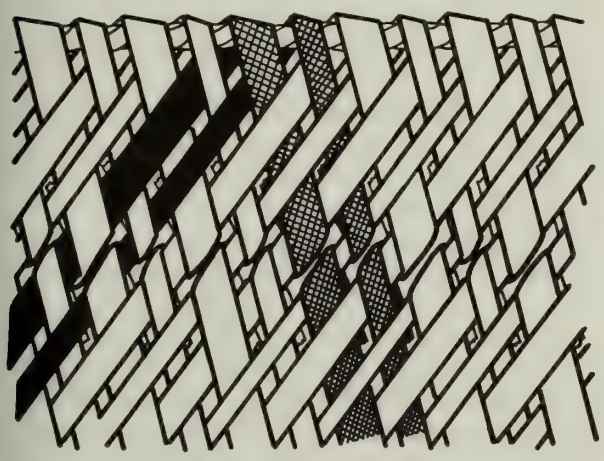


Figure 154. Schematic of selvage and reinforced shoulder of Type XXI (90° self selvage) globular bag.

plaited and have been reinforced or bound with a single course of simple 2-ply unspun S-twist twining (diameter of wefts, 1.25 mm), which engages two elements at each weft crossing. There is no provision for closing this container. The complete globular bag is initiated via radial twining on crossed warps, which become plaiting elements after several weft courses. Wefts are 2-ply Z-spun S-twist cordage (diameter, 1.9–2.75 mm). Four elements are engaged at each weft crossing with a nearly 1 cm gap between weft rows. The twining is terminated with an overhand knot. The rim selvage has terminal elements folded back at a 90° angle and replaited into the body of the bag with no further modification. There are no provisions for closure. Two specimens have reinforced 90° self selvages. In one case, a single circuit of simple 2-ply unspun S-twist twining (mean diameter of wefts, 2.40 mm) is inserted about 1.83 cm below the rim. The twining engages two elements at each weft crossing and is terminated with an overhand knot. Lengths of *Yucca angustissima* cordage have been inserted on opposite sides of this container some 9.35 mm below the rim. One of these cords is 2-ply S-spun Z-twist (diameter, 2.3–3.3 mm), while the other is 2-ply Z-twist (diameter, 2–4 mm) with one two-element Z-spun S-twist ply and one Z-spun ply. These elements are interlaced to form a half-hitch, which closes the container. In the other reinforced specimen, a two-element running stitch (diameter, 2.2–3.8 mm) is added about 3.9 mm below the rim. There are no provisions for closure. The three remaining selvages are unusual variants of the 90° self type: terminal elements are folded at a 90° angle and replaited into the body of the bag. Within the apex of the 90° folds, a length of cordage is inserted which circumscribes the rim. In two cases, the cordage is 2-ply Z-spun S-twist (mean diameter, 2.8 mm); in one case, the cordage is 2-ply Z-twist (diameter, 2.9 mm) with one two-element Z-spun S-twist ply and one Z-spun ply. On the shoulder of these bags, about 2.5 cm below the rim, a series of elements is inserted from the inside of the bag and plaited *over* the wall elements on the outside of the bag for one complete 2/2 interval. These floated elements are plaited in the same basic 2/2 interval as the remainder of the bag. Their function is problematical. They may represent a simple reinforcement for the potentially heavily used shoulders of the bag and/or they may constitute a means of stabilizing the mouth of the bag to prevent distortion. Whatever their function, the added rigidity of these floated elements insures that the cordage inserts on the rim selvage cannot be used to close the containers; closure is effected by lacing additional cordage across the mouths of the bags. In one case, a length of 2-ply Z-twist cordage (diameter, 2.9 mm) is inserted into the rim and laced sequentially across the mouth to two other loci on the rim. The result is a roughly triangular mesh-like arrangement, which effectively seals the bag, secured with a double square knot. In another case, a length of 2-ply S-spun Z-twist cordage (diameter, 2.8 mm) is laced in a triangular pattern and terminated with a half-hitch.

The cordage closure is absent on the third specimen of this variety. All bags of this type are undecorated, unpitched and not naturally watertight. The tubular bag exhibits light wear on both surfaces and five of the globular bags have moderate to heavy wear on both surfaces. One globular bag has light wear on the outside only. Five globular bags are charred and two are heavily stained.

Measurements (all specimens): Range in diameter of plaiting elements, 2.6–11.5 mm; mean diameter of plaiting elements, 4.48 mm; range in angle of crossing of plaiting elements, 54°–118°; mean angle of crossing of plaiting elements, 81.26°.

Measurements (complete globular bag): Maximum diameter of mouth, 100 mm, maximum diameter of base, 150 mm; maximum length (depth), 190 mm.

Measurements (complete tubular bag): Maximum diameter of mouth and base, 75 mm; maximum length (depth), 160 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Six-element plaited band.
Number of specimens: 3.
Type of specimens: Fragments.
Number of individual bands represented: 2.

Technique and Comments: With the exception of interval, plaited bands of this type are identical in basic configuration to Type XX plaited bands. Selvage treatment also is identical. In this variant, six single elements pass over each other in a 2/2 interval. One specimen exhibits a 2/1/1/2 shift. All specimens are undecorated, unmended, unpitched and not naturally watertight.

Measurements: Range in diameter of plaiting elements, 1.5–6.6 mm; mean diameter of plaiting elements, 3.12 mm; range in angle of crossing of plaiting elements, 75°–90°; mean angle of crossing of plaiting elements, 81.66°; range in length, 85–335 mm; mean length, 171.61 mm; range in width, 7.1–13.4 mm; mean width, 10.26 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Eight-element plaited band.
Number of specimens: 3.
Type of specimens: Fragments.
Number of individual bands represented: 3.

Technique and Comments: Eight single elements pass over each other in a 2/2 interval. One specimen exhibits 2/1/2 and 2/4/2 shifts. Another specimen is reinforced on one end with a single course of 2-ply unspun S-twist twining (mean diameter of wefts, about 1.5 mm), which engages two plaiting elements at each weft crossing. The unbraided elements on the other end of this specimen are bound with a granny knot. All specimens are undecorated, unpitched and not naturally watertight.

Measurements: Range in diameter of plaiting elements, 1.7–4 mm; mean diameter of plaiting elements, 2.92 mm; range in angle of crossing of plait-elements, 90°–110°; mean angle of crossing of plaiting elements, 96.66°; range in length, 39–100 mm; mean length, 70 mm; range in width, 11–20 mm; mean width, 17.16 mm.

Type XXI (90° selvage): Twill Plaiting, 2/2 Interval
Form: Ten-element braid.
Number of specimens: 3.
Type of specimens: Fragments.
Number of individual bands represented: 3.

Technique and Comments: Ten single and, in one case, double elements pass over each other in a 1/1 interval. Shifts include one example each of 2/1/1/2 and 2/1/2 intervals. All specimens are undecorated, unmended, unpitched and not naturally watertight. One specimen is stained on both surfaces.

Measurements: Range in diameter of plaiting elements, 2–8 mm; mean diameter of plaiting elements, 5.1 mm; range in angle of crossing of plaiting elements, 90°–100°; mean angle of crossing of plaiting elements, 93; range in length, 55–245 mm; mean length, 149 mm; range in width, 22.5–42.4 mm; mean width, 32.1 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval (Fig. 155)
Form: Twelve-element plaited band.
Number of specimens: 7.
Type of specimens: Fragments.
Number of individual bands represented: 7.

Technique and Comments: Twelve single and, in one case, double elements pass over each other in a 2/2 interval. No shifts are present. One specimen is decorated with simple linear designs



Figure 155. Type XXI (90° self selvage) 12-element plaited band fragment; note alternating light and dark plaiting elements.

produced by alternating light and dark sets of plaiting elements. Another specimen is pitched on one surface with a resinous substance and apparently is watertight. All other specimens are undecorated, unpitched and not naturally watertight. No specimens are mended. Six specimens exhibit moderate to heavy wear on both surfaces. Of these, two are stained and one is charred.

Measurements: Range in diameter of plaiting elements, 0.3–5.8 mm; mean diameter of plaiting elements, 3.28 mm; mean angle of crossing of plaiting elements, 90°; range in length, 35–370 mm; mean length, 109.48 mm; range in width, 17–49.1 mm; mean width, 32.28 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Fouteen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Fourteen single elements pass over each other in a 2/2 interval. No shifts are present. One end of the specimen is reinforced with a single course of simple 2-ply unspun Z-twist twining (mean diameter of wefts, 1.05 mm), which engages two plaiting elements at each weft crossing. The twining course is terminated with an overhand knot. The unbraided elements at the opposite end of this specimen are bound together with an overhand knot. The specimen is undecorated, unpitched and not naturally watertight. Slight wear is present on one surface.

Measurements: Range in diameter of plaiting elements, 2.3–2.8 mm; mean diameter of plaiting elements, 2.55 mm; range and mean angle of crossing of plaiting elements, 85°; length, 585 mm; width, 288 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Sixteen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Sixteen single elements pass over each other in a 2/2 interval. No shifts are present. One end of the specimen is unfinished and the unbraided elements are secured by a course of simple 2-ply unspun Z-twist twining (mean diameter of wefts, 1.3 mm) which engages two elements at each weft crossing. The twining course is terminated with an overhand knot. The specimen is undecorated, unmended, unpitched and not naturally watertight. No wear pattern is visible.

Measurements: Mean diameter of plaiting elements, 3.20 mm; mean angle of crossing of plaiting elements, 93°; length, 290 mm; width, 60 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Seventeen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Seventeen single elements pass over each other in a 2/2 interval. No shifts are present. The selvage on one end is reinforced with a single unspun untwisted element (diameter, 3.90 mm), which is sewn across the breadth of the band in the basic 2/2 production interval. An overhand knot between the two terminal elements of the end selvage and the final element of the side selvage may represent both the method and the point of completion of this specimen. A series of loops (diameter, 5.95–8.50 mm) is present on both edges of the band. These loops were produced by extending alternate plaiting elements beyond the "normal" selvage before replaiting them into the band. The function of these loops is unknown. About 3.8 cm below the end selvage, a length of macerated

Yucca sp. cordage (diameter, 5.90 mm) has been looped around the juncture of two folded elements of the side selvage and twisted twice. The two ends of this element hang free. One end is bound to another length of single-ply unspun *Yucca* sp. cordage with a square knot. This construction may represent part of a burden tie. The specimen is undecorated, unpitched and not naturally watertight. Moderate to heavy wear is present on both surfaces.

Measurements: Range in diameter of plaiting elements, 3.5–8.1 mm; mean diameter of plaiting elements, 5.8 mm; mean angle of crossing of plaiting elements, 89°; length, 51 mm; width, 69.9 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
Form: Eighteen-element plaited band.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Eight single elements pass over each other in a 2/2 interval. No shifts are present. The specimen is undecorated, unmended, unpitched and not naturally watertight. There are no wear patterns.

Measurements: Range in diameter of plaiting elements, 2.5–3 mm; mean diameter of plaiting elements, 2.75 mm; mean angle of crossing of plaiting elements, 90°; length, 250 mm; width, 42 mm.

Type XXI (90° self selvage): Twill Plaiting, 2/2 Interval
(Fig. 156 through 159)
Form: Pot rest.
Number of specimens: 4.
Type of specimens: Complete, 3; fragment, 1.

Technique and Comments: All representatives of this form group are, in effect, continuous plaited bands or cylinders which, per force, have no end selvages. The "walls" are produced via continuous radial plaiting with single elements in a basic 2/2 interval. Shifts include examples of 2/1/2, 2/3/2, 2/4/2 and 2/1/1/2 intervals. The selvage of both margins has terminal elements folded at a 90° angle and tucked into the interior of the pot rest. These tucked ends are intentionally left quite long, so as to provide additional mass, or padding, for the interior of the pot rest.



Figure 156. Type XXI (90° self selvage) "doughnut" form pot rest (plan view); note selvage treatment.

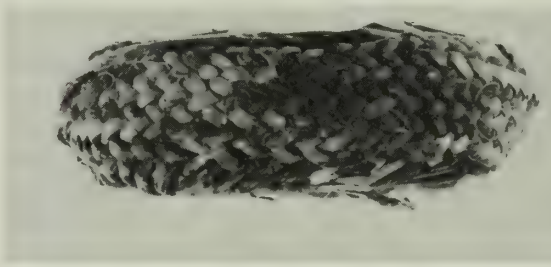
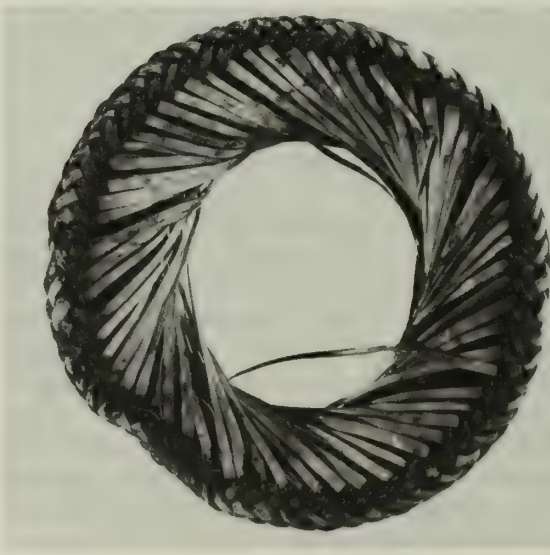


Figure 157. Type XXI (90° self selvage) "doughnut" form pot rest (side view).

Figure 158. Type XXI (90° self selvage) truncated cylinder form pot rest (plan view); note selvage treatment.



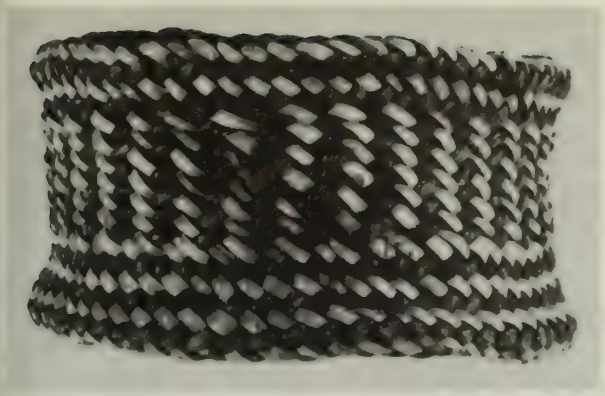


Figure 159. Type XXI (90° self selvage) truncated cylinder form pot rest (side view); note geometric design produced by alternation of dark and light plaiting elements.

Two slightly different configurations are present: a doughnut-like form represented by one specimen and a truncated cylinder represented by three specimens. The doughnut form and one cylindrical form are decorated with simple linear patterns produced by alternating sets of dark and light plaiting elements. All specimens are unmended, unpitched and not naturally watertight. The doughnut form exhibits light wear; two cylindrical forms are heavily worn and crushed or compressed through use. One of these also is charred. The third cylindrical form exhibits slight use sheen, but is otherwise unworn.

Measurements: Range in diameter of plaiting elements, 3–4 mm; mean diameter of plaiting elements, 3.67 mm; range in angle of crossing of plaiting elements, 64°–95°; mean angle of crossing of plaiting elements, 80.8°; range in exterior diameter, 122–155 mm; mean exterior diameter, 132.75; range in interior diameter, 26–65 mm; mean interior diameter, 50.75 mm; range in height (includes two compressed specimens), 14.9–62 mm; mean height (includes two compressed specimens), 32.87 mm.

Type XXI (intricate selvage with twining): Twill Plaiting,
2/2 Interval
Form: Matting.
Number of specimens: 106.
Type of specimens: Complete, 1; fragments, 105.
Number of individual mats represented: 70 (minimum).

Technique and Comments: The most common form of basketry at Antelope House is twill plaited matting with one or another variation of what is here labeled intricate selvage. This selvage type differs from all self selvages in one basic set of interrelated attributes. In 90° and 180° self selvages, the terminal elements are folded only once in the edge construction sequence. Moreover, this first and only fold is sufficient in and of itself to distinguish or delimit the type of the selvage. In all variations of intricate selvage, a minimum of two, and occasionally as many as four, folds are necessary to complete the edge finish. Whatever the variation, the construction of intricate selvages involves the same basic mechanical, or techno-manipulative, steps. The terminal elements are first folded at an obtuse angle, about 130°–150°, to the orientation of the body element of the mat. Thence, after a variable number of plaiting intervals with other similarly folded elements, it is folded again at a 90° angle to the opposite surface of the mat. This second fold is at the apex of the selvage. After the apex fold, the element is again plaited for a variable number of intervals with similarly folded elements and is then clipped off or folded a third time at a 90° angle. If a third fold is employed, the element is clipped off at variable intervals after the fold, or it is folded for a fourth time at a 90° angle and then clipped off. This double 90° fold creates, in effect, a 180° selvage termination. Because of the sheer quantity and considerable diversity of the intricate selvage matting at Antelope House, the analysis of this assemblage focused primarily on the selvage variations and only secondarily on the body plaiting type (2/2 or 3/3). All specimens of 2/2 and 3/3 plaiting with intricate selvages were collectively divided into 36 variants and one residual category based on the manipulation of the terminal element after the apex fold. Following this initial sorting, the variations were lumped into six subtypes based on the number of elements engaged after the apex fold and the manner of finishing or completing the selvage. The six subtypes and their constituent variants are listed in Table 139. The terminal act of classification lumped all subtypes into two broad types based on the presence or absence of a circuit of simple 2-ply twining reinforcements at the first obtuse angle fold. The same procedure was followed with all intricate selvage, 3/3 plaiting. The presence or absence of

Table 139. Distribution of intricate plaiting selvage variants by subtype.

Subtype	*Variant*
I	1, 9, 12, 13, 20, 31, 35
II	2, 3, 4, 5, 6, 7, 15, 16, 18, 19, 21, 22, 24, 26, 28
III	8, 11, 14, 17, 27, 30
IV	10, 25, 32
V	33, 34
VI	23, 29, 36

twining is wholly incidental to the formulation of the 36 original variants or the delimitation of the six subtypes and only serves to taxonomically classify the assemblage at the broadest possible level. The description of all 2/2 plaiting with intricate selvage and twining reinforcement is presented below by subtype or residual category.

Type XXI, Subtype I (Fig. 160 through 163)
Number of specimens: 9.
Type of specimens: Fragments.



Figure 160 (above). Type XXI (intricate selvage with twining) twill plaiting, 2/2 interval; Subtype I, Variant 1, side 1.

Figure 161 (below). Schematic of Subtype I, Variant 1, side 1.

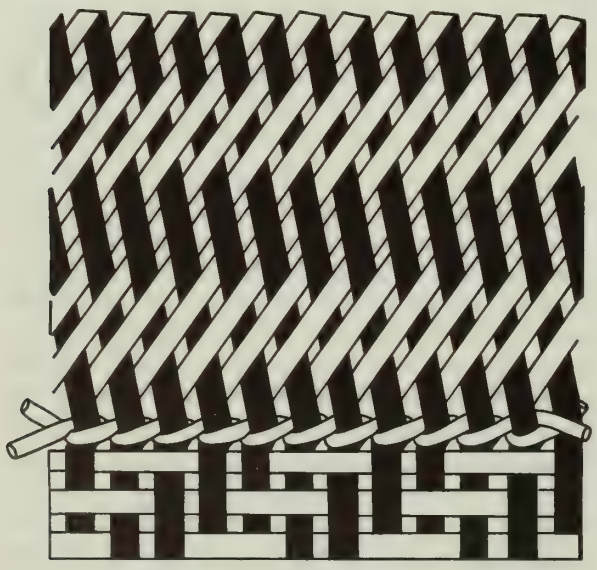
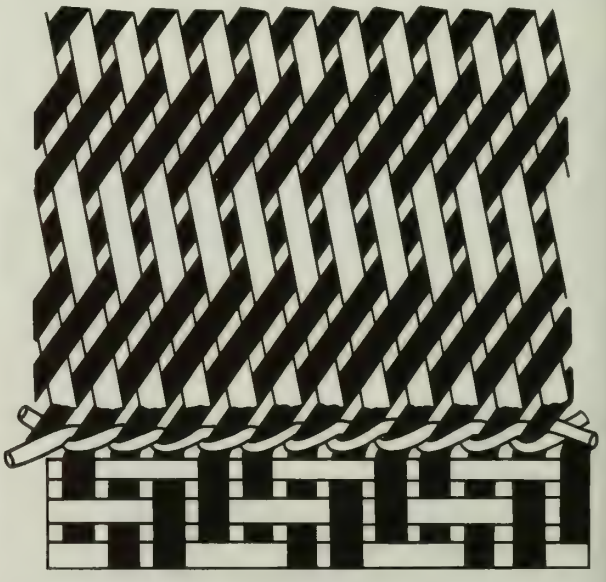




Figure 162 (above). Type XXI (intricate selvage with twining), Subtype I, Variant 1, side 2.

Figure 163 (below). Schematic of Subtype I, Variant 1, side 2.



Technique and Comments: Single elements pass over each other in a 2/2 interval. Body shifts include one example of a 2/3/2 interval. Selvages of this subtype include Variants 1, 9, 12, 13, 20, 31 and 35. These variants are lumped into a single subtype because they employ only two folds, the obtuse angle and the 90° apex, in the construction process. Termination is by clipping, without a third 90° angle fold. In Variants 1, 12, 13 and 35, the terminal elements pass over one element after the apex fold and are then plaited for a variable number of intervals until they are clipped off. In Variants 9 and 31, terminal elements pass under one element after the apex fold and are likewise plaited for a variable number of intervals before clipping. In Variant 20, terminal elements pass over two elements after the apex fold and are subsequently plaited and clipped. The complete post-apex fold plaiting sequence for all variants of this selvage subtype is presented in Table 140, together with the number of specimens per variant. There are no representatives of Variants 31 and 35 in the Type XXI intricate selvage with twining sample.

All specimens of this subtype are reinforced at the obtuse angle fold with a single circuit of simple twining. In eight cases, wefts are 2-ply unspun S-twist and engage two elements at each weft crossing; in one case, 2-ply unspun S-twist wefts engage three elements at each weft crossing. All specimens of this subtype are undecorated, unmended, unpitched and not naturally watertight. Seven specimens exhibit light to moderate wear on both surfaces and two are unworn. Three worn specimens are stained. A human coprolite adheres to the surface of one specimen. There are no representatives of Variant 28 in the Type XXI intricate selvage with twining sample.

Table 140. Variants of Type XXI, Subtype I intricate selvage with twining.

Variant	*Plaiting Sequence*	*No. Specimens*
1	Apex Fold (under 1/2/2/2) Clipped	3
9	Apex Fold (over 1/2/2/2) Clipped	1
12	Apex Fold (under 1/2/2/1) Clipped	2
13	Apex Fold (under 1/2/2/2/1) Clipped	1
20	Apex Fold (over 2/2) Clipped	2
31	Apex Fold (over 1/2/2/2) Clipped	0
35	Apex Fold (under 1/2/2/1) Clipped	0

Measurements: Range in diameter of plaiting elements, 4–9.4 mm; mean diameter of plaiting elements, 5.44 mm; range in angle of crossing of plaiting elements, (on selvage), 70°–140°; mean angle of crossing of plaiting elements, (on selvage), 110°; range in diameter of twining reinforcements, 1.5–4.7 mm; mean diameter of twining reinforcements, 4 mm; range in width of selvage, 10.9–56.7 mm; mean width of selvage, 32.2 mm.

Type XXI, Subtype II (Fig. 164 through 167)
Number of specimens: 85.
Type of specimens: Complete, 1; fragments, 84.

Technique and Comments: Single and, in one case, double elements pass over each other in a 2/2 interval. Body shifts include examples of 2/3/2 and 2/3/3/3/2 intervals. Selvages of this subtype include Variants 2, 3, 4, 5, 6, 7, 15, 16, 18, 19, 21, 22, 24, 26 and 28. These variants are lumped into a single subtype because they employ three folds—the obtuse angle, the 90° apex and a terminal 90° fold—in the construction process; in all cases, the terminal element initially passes over or under a single element after the apex fold. In Variants 2, 6, 15, 21, 22 and 26, the terminal elements pass over one element after the apex fold and are then plaited for a variable number of intervals before the third 90° fold. After the third 90° fold, the elements are again plaited for a variable number of intervals and then clipped off. In all of these variants, the last interval before the third 90° fold is over one. In Variants 4, 5, 7, 16, 24 and 28, the terminal elements again pass over one element after the apex fold and are then plaited for a variable number of intervals before the third 90° fold. In all of these variants, the last interval before the third 90° fold is under one. After the third 90° fold, the elements are plaited for a variable number of intervals and then clipped off. In Variants 3, 18 and 19, terminal elements pass under one element after the apex fold and are then plaited for a variable number of intervals before the third 90° fold. In all of these variants, the last interval before the third 90° fold is over one. After the third 90° fold, the elements are plaited for a variable number of intervals and then clipped off. The complete post-apex fold plaiting sequence for all variants of this selvage subtype is presented in Table 141, together with number of specimens per variant.

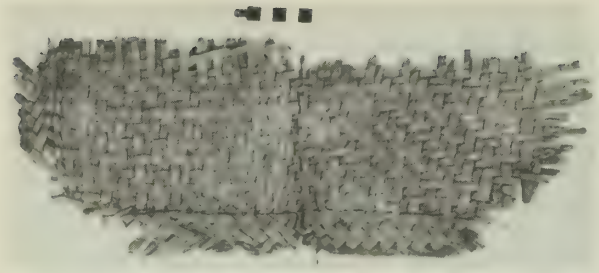


Figure 164. Type XXI (intricate selvage with twining), Subtype II, Variant 2, side 1.

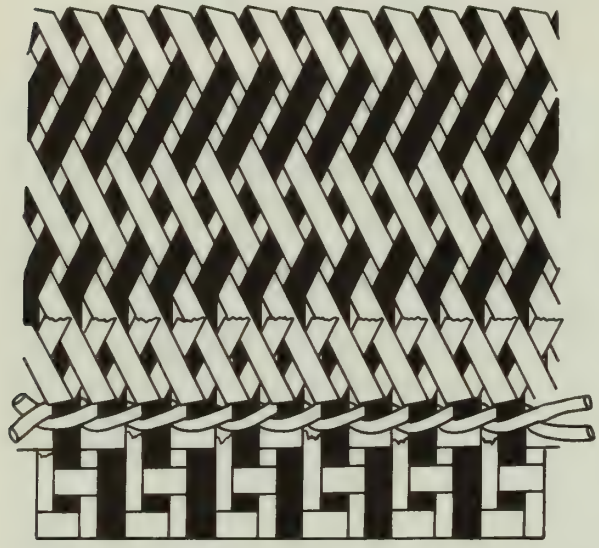


Figure 165. Schematic of Subtype II, Variant 2, side 1.

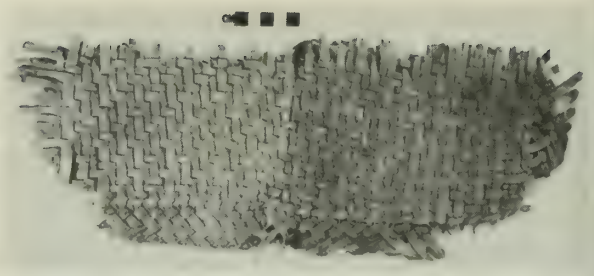


Figure 166. Type XXI (intricate selvage with twining), Subtype II, Variant 2, side 1.



Figure 167. Schematic of Subtype II, Variant 2, side 2.

All specimens of this subtype are reinforced at the obtuse angle fold with a single circuit of simple twining. In 61 cases, wefts are 2-ply unspun S-twist and engage two elements at each weft crossing; in 18 cases, identical wefts engage one element at each weft crossing. In one case, 2-ply unspun S-twist wefts engage three elements at each weft crossing. The remaining specimens include one example of 2-ply unspun Z-twist wefts engaging one element at each weft crossing; three examples of 2-ply unspun Z-twist wefts engaging one element at each weft crossing, and one example of 2-ply Z-spun S-twist cordage wefts engaging one element at each weft crossing. All specimens of this subtype are unmended, unpitched and not naturally watertight. One specimen is decorated with simple linear designs produced by alternations of sets of light and dark plaiting elements. The single complete specimen of this subtype is a large and exceptionally well preserved Variant 6 burial mat. Seventy-three specimens exhibit light to moderate wear on one surface only. Eight specimens are unworn. Foreign material adhering to the surface of one or more specimens includes *Gossypium* sp. fibers, *Zea mays* husks, seeds, plant epidermis, feathers and hair (all genus/species unknown).

Measurements: Range in diameter of plaiting elements, 1.5–13.7 mm; mean diameter of plaiting elements, 6.82 mm; range in angle of crossing of plaiting elements (on selvage), 92°–125°; mean angle of crossing of plaiting elements (on selvage), 92°–125°; mean angle of crossing of plaiting elements (on selvage), 108.94°; range in diameter of twining reinforcements, 2.1–7.8 mm; mean diammeter of twining reinforcements, 5.1

Table 141. Variants of Types XXI, Subtype II intricate selvage with twining.

Variant	*Plaiting Sequence*	*No. Specimens*
2	Apex Fold (over 1/2/2/1/1) 90° Fold (under 1) Clipped	34
3	Apex Fold (under 1/2/2/1) 90° Fold (under 1) Clipped	3
4	Apex Fold (over 1/2/2/1/1/1) 90° Fold (under 1/1) Clipped	10
5	Apex Fold (over 1/2/2/2/1/1) 90° Fold (under 1) Clipped	16
6	Apex Fold (over 1/2/2/2/1) 90° Fold (under 1) Clipped	11
7	Apex Fold (over 1/2/2/2/1/1/1) 90° Fold (over 1/1) Clipped	3
15	Apex Fold (over 1/2/2/2/2/2/1) 90° Fold (under 1) Clipped	1
16	Apex Fold (over 1/2/2/1/2/1) 90° Fold (under 1) Clipped	1
18	Apex Fold (under 1/2/1/1) 90° Fold (under 1) Clipped	1
19	Apex Fold (under 1/2/2/2/2/1) 90° Fold (under 1) Clipped	1
21	Apex Fold (over 1/2/1/1) 90° Fold (under 1) Clipped	1
22	Apex Fold (over 1/1/2/1/1) 90° Fold (under 1) Clipped	1
24	Apex Fold (over 1/2/2/2/2/1) 90° Fold (over 1/1) Clipped	1
26	Apex Fold (over 1/2/2/2/2/1/1) 90° Fold (under 1) Clipped	1
28	Apex Fold (over 1/2/2/2/2/2/1/1) 90° Fold (over 1/1) Clipped	0

Table 142. Variants of Type XXI, Subtype III intricate selvage with twining.

Variant	*Plaiting Sequence*	*No. Specimens*
8	Apex Fold (under 2/2/2/1) 90° Fold (under 1) Clipped	1
11	Apex Fold (over 2/2/1/1/1) 90° Fold (under 1) Clipped	1
14	Apex Fold (over 2/2/2/1/1/1) 90° Fold (over 1/1) Clipped	1
17	Apex Fold (over 2/2/2/1/1) 90° Fold (over 1/1) Clipped	1
27	Apex Fold (over 2/2/2/2/2/1) 90° Fold (over 1/1) Clipped	0
30	Apex Fold (under 2/2/2/1/1) 90° Fold (over 1/1) Clipped	0

mm; range in width of selvage, 11.1–66.5 mm; mean width of selvage, 34.82 mm; length (complete specimen), 1180 mm; width (complete specimen), 1120 mm.

Type XXI, Subtype III (Fig. 168 through 171).
Number of specimens: 4.
Type of specimens: Fragments, 4.

Technique and Comments: Single elements pass over each other in a 2/2 interval. Body shifts include examples of 2/1/2, 2/3/2 and 2/6/2 intervals. Selvages of this subtype include Variants, 8, 11, 14, 17, 27 and 30. These variants are lumped into a single subtype because they employ three folds—the obtuse angle, the 90° apex and a terminal 90° fold—in the construction process; in all cases, the terminal element initially passes over or under a single element after the apex fold. In Variants 11, 14, 17 and 27, the terminal elements pass over two elements after the apex fold and are then plaited for a variable number of intervals before the third 90° fold. After the third 90° fold, the elements are again plaited for a variable number of intervals and then clipped off. In Variants 8 and 30, the basic selvage construction sequence is as described above, except that terminal elements initially pass under two elements after the 90° apex fold. The complete post-apex fold plaiting sequence for all variants of this selvage subtype is presented in Table 142, together with number of specimens per variant. There are no representatives of Variants 27 and 30 in the Type XXI intricate selvage with twining sample.

All samples of this subtype are reinforced at the obtuse angle fold with a single circuit of simple twining. In three cases, wefts are 2-ply unspun S-twist and engage two elements at each weft crossing; in one case, 2-ply unspun Z-twist wefts engage one element at each weft crossing. All specimens of this subtype are undecorated, unmended, unpitched and not naturally watertight. Three specimens exhibit moderate wear on

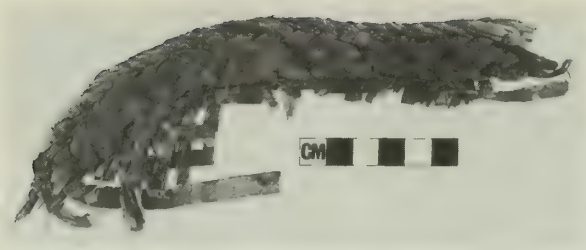


Figure 168. Type XXI (intricate selvage with twining), Subtype III, Variant 11, side 1.



Figure 170. Type XXI (intricate selvage with twining), Subtype III, Variant 11, side 2.

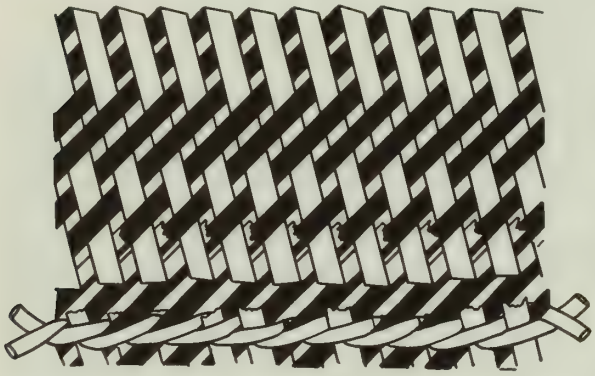


Figure 169. Schematic of Subtype III, Variant 11, side 2.

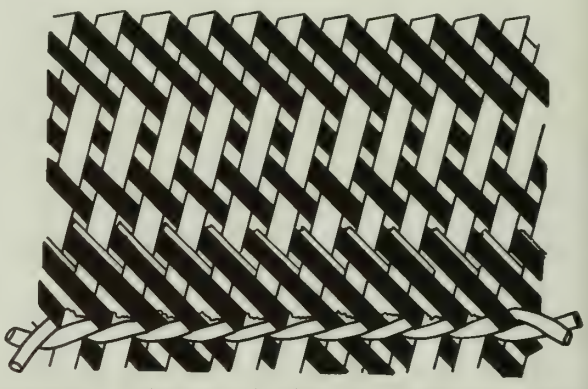


Figure 171. Schematic of Subtype III, Variant 11, side 2.

both surfaces and one specimen is heavily worn on one surface only; one specimen with wear on both sides is charred. A coprolite adheres to the surface of one specimen.

Measurements: Range in diameter of plaiting elements, 2.7–9 mm; mean diameter of plaiting elements, 7 mm; range in angle of crossing of plaiting elements (on selvage), 98°–120°; mean angle of crossing of plaiting elements (on selvage), 112.5°; range in diameter of twining reinforcements, 3.5–5.9 mm; mean diameter of twining reinforcements, 4.7 mm; range in width of selvage, 24.4–38.7 mm; mean width of selvage, 32.5 mm.

Type XXI, Subtype IV
Number of specimens: 2.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. Body shifts include one example of a 2/1/2 interval. Selvages of this subtype include Variants 10, 25 and 32. These variants are lumped into a single subtype because they employ three folds—the obtuse angle, the 90° apex and a terminal 90° fold—in the construction process; in all cases, the terminal element initially passes over a single element after the 90° apex fold. The post-apex fold plaiting sequence of these variants is sufficiently distinct from any Subtype II variants to warrant placing them in a separate subtype. In all Subtype IV variants, the terminal elements pass over one element after the 90° apex fold and are plaited for a variable number of intervals before the third 90° fold. After the third 90° fold, the elements are again plaited for a variable number of intervals and then clipped off. The complete post-apex fold plaiting sequence is presented in Table 143, together with number of specimens per variant. There are no representatives of Variant 25 in the Type XXI intricate selvage with twining sample.

All specimens of this subtype are reinforced at the obtuse angle fold with a single circuit of simple twining. In both cases, wefts are 2-ply unspun S-twist and engage two elements at each weft crossing. Both specimens are undecorated, unmended, unpitched and not naturally watertight. Both specimens exhibit moderate to heavy

Table 143. Variants of Type XXI, Subtype IV intricate selvage with twining.

Variant	*Plaiting Sequence*	*No. Specimens*
10	Apex Fold (over 1/2/2/2/2/2/2/1) 90° Fold (over 1/2) Clipped	1
25	Apex Fold (over 1/2/2/2/1) 90° Fold (over 1/2) Clipped	0
32	Apex Fold (over 1/2/2/1/2/2/1) 90° Fold (under 1/2/1) Clipped	1

wear on both surfaces. One specimen is charred.

Measurements: Range in diameter of plaiting elements, 5.5–10.1 mm; mean diameter of plaiting elements (on selvage), 8 mm; mean angle of crossing of plaiting elements (on selvages), 108°; range in diameter of twining reinforcements, 6.6–6.7 mm; mean diameter of twining reinforcements, 6.65 mm; range in width of selvage, 51.5–64 mm; mean width of selvage, 57.75 mm.

(There are no representatives of selvage Subtype V in the Type XXI intricate selvage with twining sample.)

Type XXI, Subtype VI (Fig. 172 through 175)
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 2/2 interval. Body shifts include examples of 2/1/2 and 2/3/2 intervals. Selvages of this subtype include Variants 23, 29 and 36, but only Variant 23 is represented here. These variants are lumped into a single subtype because they employ four folds—the obtuse angle, the 90° apex and two terminal 90° folds—in the construction process; in all cases, terminal elements pass over and one element after the 90° apex fold and are plaited for a variable number of intervals before the third 90° fold. After the third 90° fold, the elements are again plaited for a variable number of intervals and then folded for a fourth time at a 90° angle. After the final 90° fold, the elements are plaited for another variable interval and then clipped. The complete post-apex fold plaiting sequence for Variant 23 is: apex fold (over 1/2/2/2) 90° fold (over 1/1) 90° fold (over 1/2) clipped. In the single specimen of the subtype in the Type XXI intricate selvage with twining sample, 2-ply unspun Z-twist wefts engage two elements at each weft crossing. The specimen is undecorated, unmended, unpitched and not naturally watertight. Light to moderate wear is present on both surfaces.

Measurements: Range in diameter of plaiting elements, 4–7.7 mm; mean diameter of plaiting elements, 5.44 mm; mean angle of crossing of plaiting elements (on selvage), 105°; mean diameter of twining reinforcements, 3.9 mm; width of selvage, 39.7 mm.

Type XXI, Subtype Unknown
Number of specimens: 5.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Due to the very fragmentary condition of these specimens, the post-apex fold plaiting sequence is not discernible. All of the extant twining reinforcements are 2-ply unspun S-twist and engage two elements at each weft crossing. All specimens are undecorated, unmended, unpitched and not naturally watertight. Four specimens exhibit moderate wear on both surfaces and one specimen is heavily worn on one surface only. Two specimens worn on both sides are charred. A white feather (genus/species unknown) adheres to the surface of one specimen.

Measurements: Range in diameter of plaiting elements, 2.5–9.7 mm; mean diameter of plaiting elements, 6.88 mm; range in angle of crossing of plaiting elements (on selvage), 92°–110°; mean angle of crossing of plaiting elements, 102.4°; range in diameter of twining reinforcements, 3.4–5.7 mm; mean diameter of twining reinforcements, 4.86 mm.

Type XXI (intricate selvage without twining): Twill Plaiting, 2/2 Interval
Form: Matting.
Number of specimens: 71.
Type of specimens: Fragments.

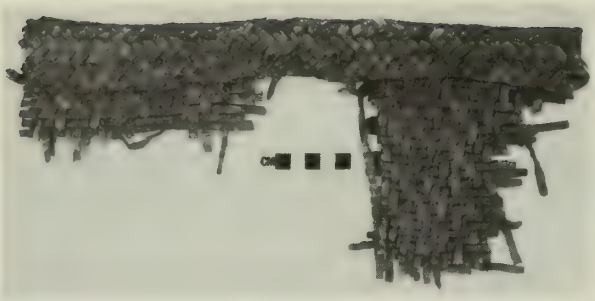


Figure 172. Type XXI (intricate selvage with twining), Subtype VI, Variant 23, side 1.



Figure 174. Type XXI (intricate selvage with twining), Subtype VI, Variant 23, side 2.



Figure 173. Schematic of Subtype VI, Variant 23, side 1.

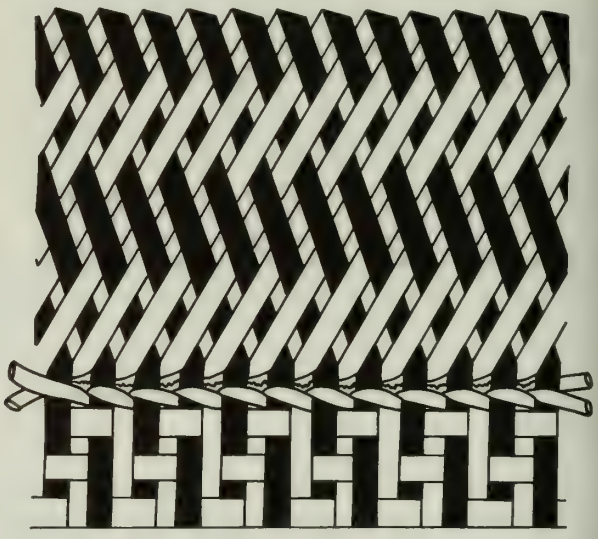


Figure 175. Schematic of Subtype VI, Variant 23, side 2.

Technique and Comments: All specimens of Type XXI intricate selvage without twining reinforcements are described below by subtype. With the exception of the absence of a circuit of simple twining at the obtuse angle fold, these subtypes are identical in all particulars to the subtypes of Type XXI described above.

Type XXI, Subtype I
Number of specimens: 5.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Selvages of this subtype include two examples of Variant 12 and one each of Variants 1, 20 and 31. There are no representatives of Variants 9, 13, and 35. All specimens are undecorated, unmended, unpitched and not naturally watertight. Four specimens exhibit light to moderate wear on both surfaces and one specimen is heavily worn on one surface only. One specimen worn on both sides also is stained.

Measurements: Range in diameter of plaiting elements, 1.22–8 mm; mean diameter of plaiting elements, 5 mm; range in angle of crossing of plaiting elements (on selvage), 73°–112°; mean angle of crossing of plaiting elements (on selvage), 98°; range in width of selvage, 16.8–41.9 mm; mean width of selvage, 30 mm.

Type XXI, Subtype II
Number of specimens: 55.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. Body shifts include numerous examples of 2/1/2 intervals. Selvages of this subtype include 23 examples of Variant 2, eight examples of Variant 4, 10 examples of Variant 5, nine examples of Variant 6, one example each of Variants 7 and 26, and two examples of Variant 28. There are no representatives of Variants 3, 15, 16, 18, 19, 21, 22 and 24. All specimens are undecorated, unmended, unpitched and not naturally watertight. Forty-five specimens exhibit light to moderate wear on both surfaces and six are heavily worn on both surfaces. Four specimens exhibit moderate to heavy wear on one surface only. Sixteen specimens worn on both sides are charred and 13 are stained. Foreign material adhering to the surface of one or more specimens include human hair, *Gossypium* sp. fibers and *Cucurbita pepo* fragments, as well as unidentified plant epidermis, feathers and seeds.

Measurements: Range in diameter of plaiting elements, 3.22–17 mm; mean diameter of plaiting elements, 7.37 mm; range in angle of crossing of plaiting elements (on selvage), 100°–131°; mean angle of crossing of plaiting elements (on selvage), 111.89 mm; range in width of selvage, 16.5–32 mm; mean width of selvage, 24.15 mm.

Type XXI, Subtype III
Number of specimens: 2.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Selvages of this subtype include one example each of Variants 27 and 30. There are no representatives of Variants 8, 11, 14 and 17. Both specimens are undecorated, unmended, unpitched and not naturally watertight. One specimen has moderate to heavy wear on both surfaces and the other is lightly worn on one surface only.

Measurements: Range in diameter of plaiting elements, 2.5–6 mm; mean diameter of plaiting elements, 4.12 mm; range in angle of crossing of plaiting elements (on selvage), 94°–105°; mean angle of crossing of plaiting elements (on selvage), 99.5°; range in width of selvage, 16.5–32 mm; mean width of selvage, 24.25 mm.

Type XXI, Subtype IV (Fig. 176 through 179)
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. The single specimen of this subtype has a Variant 25 selvage. The specimen is undecorated, unmended, unpitched and not naturally watertight. Moderate wear is present on both surfaces. The specimen is stained.

Measurements: Mean diameter of plaiting elements, 5 mm; mean angle of crossing of plaiting elements (on selvage), 92°; width of selvage, 37.4 mm.

Type XXI, Subtype V (Fig. 180 through 183)
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Selvages of this subtype include Variants 33 and 34. These variants are lumped into a single subtype because they employ three folds—the obtuse angle, the 90° apex and a terminal 90° fold—in the construction process; in all cases, they employ a 2/3 interval in the post-apex fold construction sequence. In all subtype V variants, the terminal elements pass over one element after the 90° apex fold. After the third 90° fold, the elements are again plaited for a variable number of intervals and then clipped off. The complete post-apex fold plaiting sequence for Variant 33, which is represented here, is: apex fold (over 1/2/2/2/3) 90° fold (over 1/1) clipped. The single specimen of this subtype is undecorated, unmended, unpitched and not naturally watertight. Moderate wear is present on both surfaces.

Measurements: Range in diameter of plaiting elements, 7.2–10.2 mm; mean diameter of plaiting elements, 8.7 mm; mean angle of crossing of plaiting elements (on selvage), 114°; width of selvage, 60.6 mm.

Type XXI, Subtype VI (Fig. 184 through 187)
Number of specimens: 2.
Type of specimens: Fragments.



Figure 176. Type XXI (intricate selvage with twining), Subtype IV, Variant 25, side 1.



Figure 178. Type XXI (intricate selvage with twining), Subtype IV, Variant 25, side 2.



Figure 177. Schematic of Subtype IV, Variant 25, side 1.

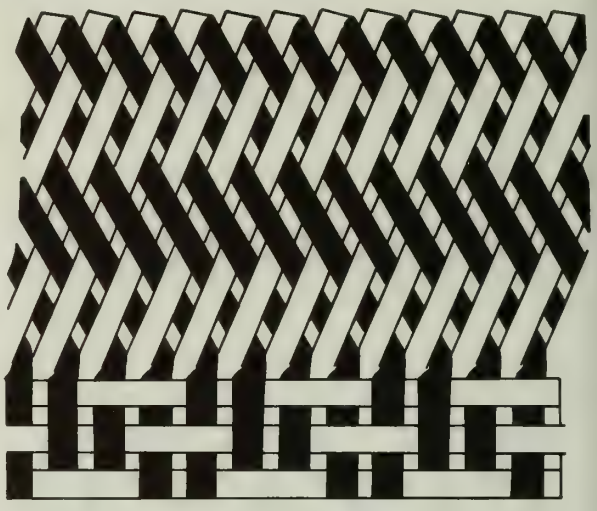


Figure 179. Schematic of Subtype IV, Variant 25, side 2.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Selvages of this sub-type include one example each of variants 29 and 36. There are no representatives of Variant 23 in the Antelope House sample. Both specimens are undecorated, unmended, unpitched and not naturally watertight. Both specimens exhibit light wear on both surfaces. One has an incinerated substance of unknown composition adhering to one surface.

Measurements: Range in diameter of plaiting elements, 4.4–7 mm; mean diameter of plaiting elements, 6.13 mm; range in angle of crossing of plaiting elements (on selvage), 93°–106°; mean angle of crossing of plaiting elements (on selvage), 99.5°; range in width of selvage, 37.4–38.6 mm; mean width of selvage, 38 mm.

Type XXI, Subtype Unknown

Number of specimens: 5.

Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 2/2 interval. No body shifts are present. Due to the fragmentary condition of these specimens, the post-apex fold plaiting sequence is not discernible. All specimens are undecorated, unmended, unpitched and not naturally watertight. All specimens exhibit moderate attrition wear on both surfaces and one is charred.

Measurements: Range in diameter of plaiting elements, 4.3–9 mm; mean diameter of plaiting

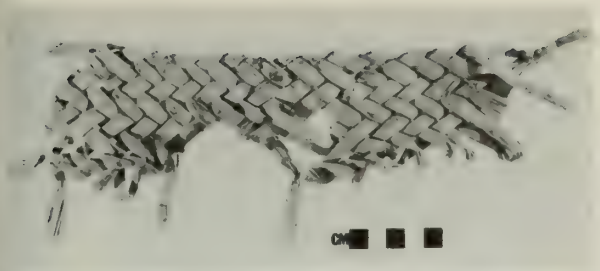


Figure 180. Type XXI (intricate selvage with twining), Subtype V, Variant 33, side 1.



Figure 182. Type XXI (intricate selvage with twining), Subtype V, Variant 33, side 2.

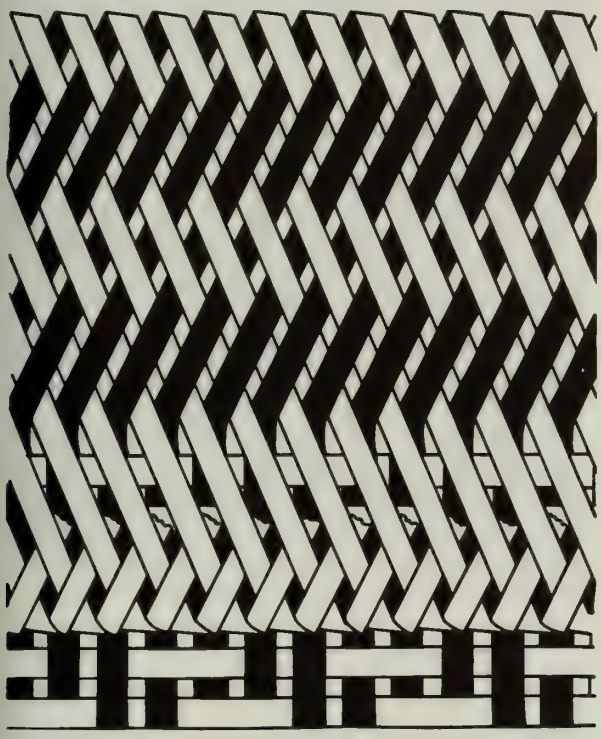


Figure 181. Schematic of Subtype V, Variant 33, side 1.

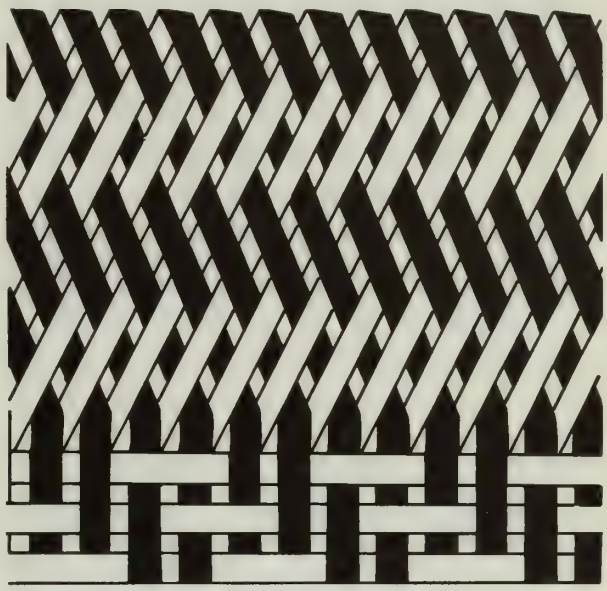


Figure 183. Schematic of Subtype V, Variant 33, side 2.

elements, 6.61 mm; range in angle of crossing of plaiting elements (on selvage), 90°–113°; mean angle of crossing of plaiting elements (on selvage), 104°.

Type XXI (180° self selvage): Twill Plaiting, 2/2 Interval

(Fig. 188, 189, 190)

Form: Ring basket.

Number of specimens: 27.

Type of specimens: Complete, 5; fragments, 22.

Number of individual ring baskets represented: 26 (minimum).

Technique and Comments: These and all other ring baskets from Antelope House conform in most particulars to the basic construction pattern described by Morris and Burgh (1942: 19–20). A flat plaited mat without selvage is produced and subjected to prolonged immersion in water. The mat then is distorted to the desired configuration (e.g., bowl or tray) by forcing it through or around a hoop or ring of *Rhus* sp. or *Salix* sp. The basic selvage treatment has terminal elements folded at a 180° angle around the wooden ring after which they are secured either by simple twining or a double twined running stitch and clipped off. The selvage may be folded to the inside of the vessel or to the outside. In this variant, single elements pass over each other in a 2/2 interval. Shifts include examples of 2/1/2,

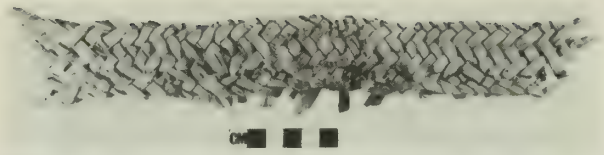


Figure 184. Type XXI (intricate selvage with twining), Subtype VI, Variant 36, side 1.

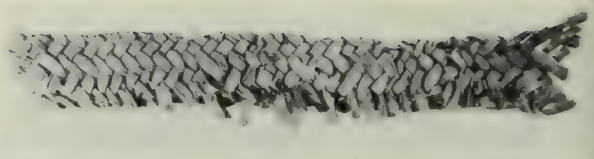


Figure 186. Type XXI (intricate selvage with twining), Subtype VI, Variant 36, side 2.

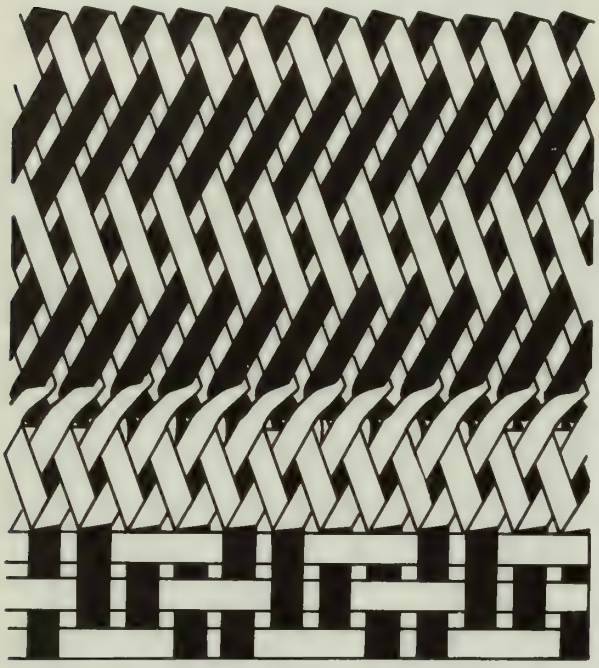


Figure 185 (above). Schematic of Subtype VI, Variant 36, side 1.

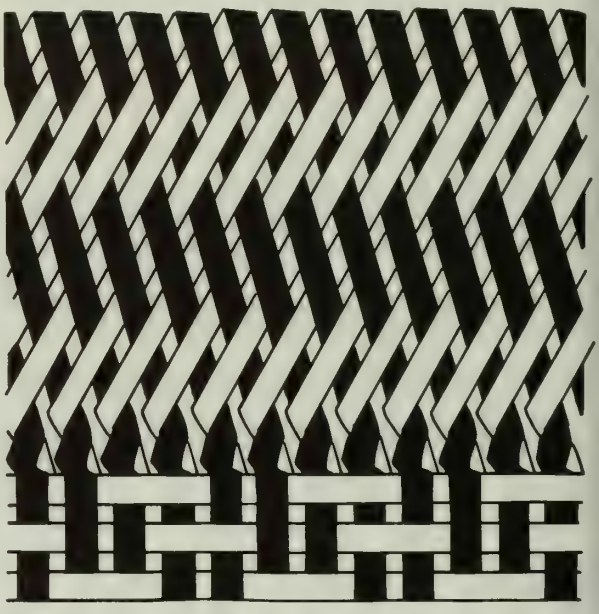


Figure 187 (above). Schematic of Subtype VI, Variant 36, side 2.

Figure 188 (below). Type XXI (180° self selvage) ring basket with plait meander design; convex surface.

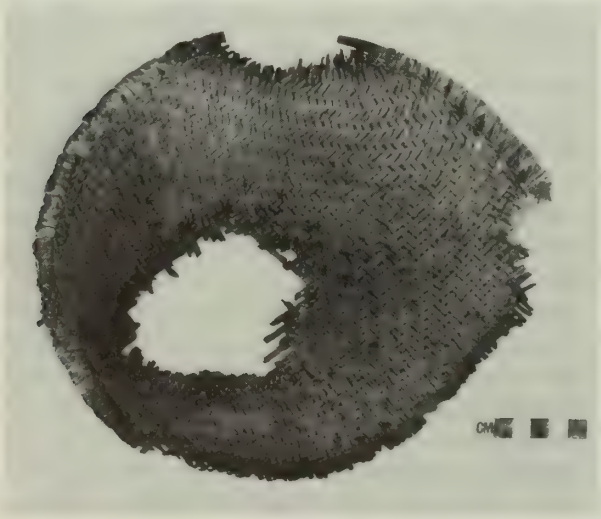


Figure 189 (below). Complete Type XXI (180° self selvage) ring basket with plain meander design; convex surface.

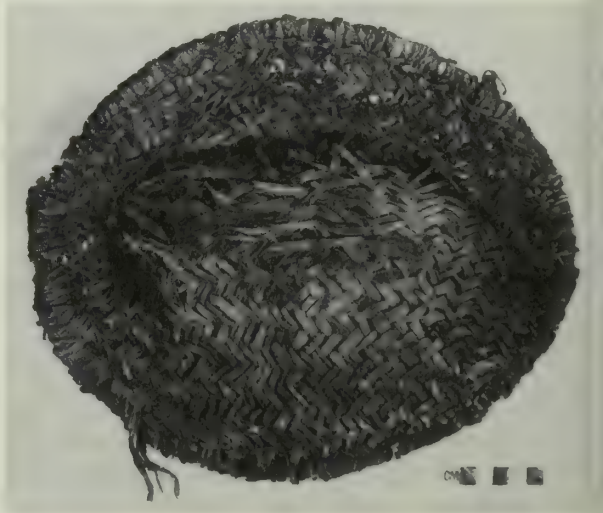




Figure 190. Type XXI (180° self selvage) ring basket fragment; concave surface. Note double twined running stitch securing selvage.

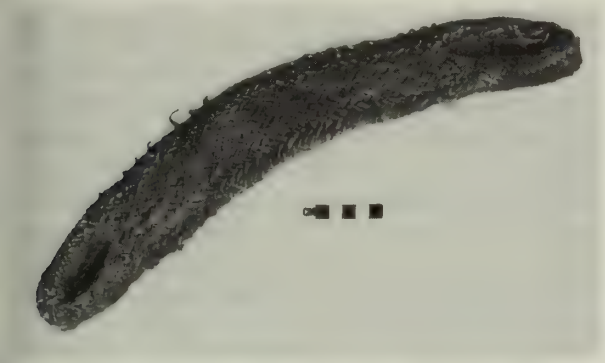


Figure 191. Complete Type XXI (continuous selvage) compound construction tumpline; concave surface. Note human hair running stitches on both margins of body.

2/3/2, 2/6/2, 2/3/3/2, 2/1/1/1/2 and 2/3/1/3/2 intervals. In eight cases, one or more of these shifts is regularly employed to produce patterns on the bases of the baskets. In all cases, patterns are variations of the plain meanders figured by Morris and Burgh (1942: Fig. 10 f, g). In seven cases, the ring is *Rhus* sp. with cortex, and in four cases *Salix* sp. with cortex. Four other rings are decorticated *Salix* sp. In all other representatives of this variant, the wooden rings are missing. On 17 specimens, the selvage is folded to the outer surface of the basket, and in six cases, it is folded to the interior. In four cases, direction of folding is not discernible. In 23 specimens, the folded selvage is secured by a single circuit of 2-ply twining with unspun wefts. Sixteen of these twining circuits are S-twist and seven are Z-twist. The selvage of one specimen is secured with 2-ply Z-spun S-twist cordage wefts. In the remaining three specimens, a double twined running stitch is employed to secure the selvage (cf. Emery 1966: Fig. 353). Two to four terminal elements are engaged at each crossing with wefts or running stitches. In most cases, the binding circuit is terminated by a simple overhand knot, but there is one example each of termination by a square knot and a granny knot. The complete specimens include two shallow bowls and three shallow trays. All specimens are unmended, unpitched and not naturally watertight. Twenty-three specimens exhibit moderate to heavy wear on both surfaces and two exhibit moderate wear on the interior surface only. Nine worn specimens also are charred. Four worn specimens are heavily stained. One specimen exhibits use sheen on the exterior surface but is otherwise unworn. Foreign matter adhering to the surface of one or more specimens includes fibers of *Gossypium* sp., coprolites, husks of *Zea mays* and feathers (genus/species unknown).

Measurements (all specimens): Range in diameter of plaiting elements, 2–8 mm; mean diameter of plaiting elements, 4.45 mm; range in angle of crossing of plaiting elements, 80°–150°; mean angle of crossing of plaiting elements, 91.8°; range in diameter of ring, 3–96 mm; mean diameter of ring, 6.66 mm; range in diameter of binding circuit, 1–5 mm; mean diameter of binding circuit, 2.46 mm; range in number of elements bound at each weft or running stitch crossing, 2–4; mean number of elements bound at each weft or running stitch crossing, 2.22.

Measurements (complete specimens): Container 1—maximum diameter of rim, 90 mm; maximum depth, N.A. (specimen is compressed). Container 2—maximum diameter of rim, 149 mm; maximum depth, 32 mm. Container 3—maximum diameter of rim, 250 mm; maximum depth, 60 mm. Container 4—maximum diameter of rim, 290 mm; maximum depth, N.A. (specimen is compressed). Container 5—maximum diameter of rim, 13 mm; maximum depth, 10 mm.

Type XXI (continuous selvage): Twill Plaiting, 2/2 Interval (Fig. 191)
Form: Tumpline.
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: One complete Type XXI and one complete Type XXII tumpline were recovered from Antelope House. Though construction details vary, their basic configurations are similar. Tumplines are elongate, plaited burden supports, or carriers, with an integral loop or aperture at either end. They may be one-piece constructions or a number of separate pieces may be combined to produce a compound plaited construction. Since the finished tumplines, notably the Type XXII specimen, have no real edges or rims, the selvage variety is herein designated as continuous. The single Type XXI tumpline is a compound construction composed of four separate parts. The body of the tumpline is made of two plaited bands, one of 20 and the other of 28 elements. The end loops are 40- and 48-element plaited bands, respectively. In all cases, the component bands pass over each other in a 2/2 interval. Occasional 2/3/2 and 2/1/3/1/2 shifts are present. The two bands that compose the body of the tumpline are arranged back-to-back and are joined on both margins with a circuit of overcast or whipping stitches. The stitches are single-ply unspun *Yucca angustissima* elements (mean diameter, 2 mm). Near the midpoint of one margin, an exhausted stitching element is spliced to a new element with a square knot. The bands that compose the end loops are folded into a U-shape with their side selvages facing inward and are affixed to the tumpline by plaiting the open ends of the body bands to the open ends of the loop bands. The interplaiting is reinforced with several irregular circuits of simple 2-ply unspun S-twist twining (mean diameter, 1.9 mm). These *Yucca angustissima* twining circuits are terminated with square knots. The side selvages on the interior portions of the end loops are stitched together with overcast or whipping stitches, again composed of single-ply unspun *Yucca angustissima* elements. Where necessary, these elements are spliced with overhand knots. The specimen is decorated with a row of running stitches along both margins of the body some 1–1.5 cm from the edge. While most of the stitching elements are missing, the extant segments appear to be 2-ply Z-spun S-twist human hair cordage (mean diameter, 4 mm). This specimen is unmended, unpitched and not naturally watertight. Light wear is present on the convex, or exterior, surface and the concave, or interior, surface has light use sheen.

Measurements: Range in diameter of plaiting elements, 1.7–6 mm; mean diameter of plaiting elements, 3.51 mm; mean angle of crossing of plaiting elements, 80°; maximum interior diameter of end loops, 52 mm; minimum interior diameter of end loops, 11 mm; length, 456 mm; width, 69 mm; thickness (at midpoint of body), 9.6 mm.

Type XXII (90° self selvage): Twill Plaiting, 3/3 Interval Form: Matting.
Number of specimens: 3.
Type of specimens: Fragments.
Number of individual mats represented: 3.

Technique and Comments: Single elements pass over each other in a 3/3 interval. Shifts include examples of 3/1/3 and 3/2/3 intervals. Selvage treatment has terminal elements folded back at a 90° angle and replaited into the body of the mat. Two specimens have an additional wrapping stitch at the apex of the 90° folds. The wrapping stitch adds rigidity to the basic 90° selvage. All specimens are undecorated, unpitched and not naturally watertight. One specimen has been mended via insertion of a new plaiting element, which is affixed to a worn element with a figure-8 knot. All specimens exhibit moderate to heavy wear on both surfaces.

Measurements: Range in diameter of plaiting elements, 4.15–9.20 mm; mean diameter of plaiting elements, 6.71 mm; range in angle of crossing of plaiting elements, 80°–93°; mean angle of crossing of plaiting elements, 84.33°.

Type XXII (90° self selvage): Twill Plaiting, 3/3 Interval
Form: Four-element plaited band.
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: With the exception of interval, plaited bands of this type are identical in basic configuration to Types XX and XXI plaited bands. Selvage treatment is likewise identical. In this variant, four double or treble elements functioning as a unit pass over each other in a 3/3 interval. There are no shifts. The specimen is undecorated, unmended, unpitched and not naturally watertight. Heavy wear is present on both surfaces. The specimen is charred and fibers of *Gossypium* sp. adhere to one surface.

Measurements: Mean diameter of plaiting elements, 12 mm; mean angle of crossing of plaiting elements, 70°; length, 140 mm; width, 12.8 mm.

Type XXII (90° self selvage): Twill Plaiting, 3/3 Interval Form: Pot rest.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: With the exception of interval, the single representative of this form group is identical to the truncated cylinder pot rests of Type XXI. In this variant, single elements pass over each other in a 3/3 interval. Shifts include examples of 3/1/1/2/1/1/3 and 3/2/2/2/3 intervals. The specimen is undecorated, unmended, unpitched and not naturally watertight. Heavy wear is present on all surfaces and this specimen is crushed through use. The specimen is charred and *Gossypium* sp. fibers adhere to one surface.

Measurements: Mean diameter of plaiting elements, 3 mm; mean angle of crossing of plaiting elements, 68°; exterior diameter, 122 mm; interior diameter, 52 mm; height (specimen is compressed) 15.5 mm

Type XXII (intricate selvage with twining): Twill Plaiting, 3/3 Interval
Form: Matting.
Number of specimens: 7.
Type of specimens: Fragments.

Technique and Comments: All specimens of Type XXII intricate selvage with twining reinforcements are described below by subtype. With the exception of body plaiting interval, these subtypes are identical to the Type XXI intricate selvage with twining subtypes. There are no representatives of Subtypes III, IV or VI in the Type XXII intricate selvage with twining sample.

Type XXII, Subtype I
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 3/3 interval. No body shifts are present. The single specimen of this subtype has a Variant 35 selvage. The specimen is reinforced at the obtuse angle fold with a single circuit of simple 2-ply unspun S-twist twining, which engages two elements at each weft crossing. The specimen is undecorated, unmended, unpitched and not naturally watertight. A length of 2-ply S-spun Z-twist *Yucca* sp. cordage (mean diameter, 3.2 mm) is affixed near the apex fold and is secured with a granny knot and a square knot. The function of this cordage is unknown. Moderate wear is present on both surfaces.

Measurements: Mean diameter of plaiting elements, 6.5 mm; mean angle of crossing of plaiting elements (on selvage), 77°; mean diameter of twining reinforcements, 5.5 mm; width of selvage, 40 mm.

Type XXII, Subtype II
Number of specimens: 5.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in a 3/3 interval. No body shifts are present. Selvages of this subtype include four examples of Variant 5 and one of Variant 7. All specimens of this subtype are reinforced at the obtuse angle fold with a single circuit of twining. In two cases, wefts are 2-ply unspun S-twist and engage two elements at each weft crossing. In three cases, identical wefts engage three elements at each weft crossing. All specimens are undecorated, unmended, unpitched and not naturally watertight. Three specimens exhibit moderate to heavy wear on both surfaces and two have moderate to heavy wear on one surface only. Three specimens worn on both surfaces are charred and one specimen worn on one surface is stained. A granular substance of unknown composition adheres to both surfaces of one specimen.

Measurements: Range in diameter of plaiting elements, 3.2–9.5 mm; mean diameter of plaiting elements, 5.29 mm; range in angle of crossing of plaiting elements (on selvage), 104°–117°; mean angle of crossing of plaiting elements (on selvage), 109.8°; range in diameter of twining reinforcements, 3.6–6.2 mm; mean diameter of twining reinforcements, 4.58 mm; range in width of selvage, 21.9–62.7 mm; mean width of selvage, 34.48 mm.

Type XXII, Subtype V
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: Single elements pass over each other in a 3/3 interval. Body shifts include examples of 3/1/3 and 3/5/3 intervals. The single specimen of this subtype has a Variant 34 selvage. The specimen is reinforced at the obtuse angle fold with a single circuit of simple 2-ply unspun, S-twist twining which engages two elements at each weft crossing. The specimen is undecorated, unmended, unpitched, and not naturally watertight. Moderate attrition wear is present on both surfaces. Additionally, feathers (genus/species unknown), *Zea mays* husks and a coprolite are adhering to one surface of the specimen.

Measurements: Range in diameter of plaiting elements, 4–7 mm; mean diameter of plaiting elements, 5.5 mm; range and mean angle of crossing of plaiting elements (on selvage), 110°; range and mean diameter of twining reinforcements, 5.4 mm; width of selvage, 46.5 mm.

Chronological Position	*Material*	*Provenience*	*No. Specimen*
MP–III	*Scirpus* spp.	South Room Block Rm. 21	1

Type XXII(intricate selvage without twining): Twill Plaiting, 3/3 Interval (cont.)
Form: Matting.
Number of specimens: 2.
Type of specimens: Fragments, 2.

Technique and Comments: All specimens of Type XXII intricate selvage without twining reinforcements are described below by subtype. With the exception of body plaiting interval, these subtypes are identical in all particulars to the Type XXI intricate selvage without twining subtypes. There are no representatives of Subtypes I, III, IV, V or VI in the Type XXII intricate selvage without twining sample.

Subtype II
Number of specimens: 2.
Type of specimens: Fragments, 2.

Technique and Comments: Single elements pass over each other in a 3/3 interval. There are no body shifts represented. Selvages include two examples of Variant 5. There are no representatives of Variants 2, 3, 4, 6, 7, 15, 16, 18, 21, 22, 24, 26 and 28 in the Type XXII intricate selvage without twining sample. Both specimens are undecorated, unmended, unpitched, and not naturally watertight. Both specimens exhibit moderate to heavy attrition wear on both surfaces. Additionally, one is stained and the other is charred.

Measurements: Range in diameter of plaiting elements, 3–8.3 mm; mean diameter of plaiting elements, 5.75 mm; range in angle of crossing of plaiting elements (on selvage), 102°–111°; mean angle of crossing of plaiting elements (on selvage), 106.5°; range in width of selvage, 37–41 mm; mean width of selvage, 39 mm.

Chronological Position	*Material*	*Provenience*	*No. Specimens*
EP–III	*Scirpus* spp.	South Room Block Rm. 21 Flr. 2	2

Type XXII (180° self selvage): Twill Plaiting, 3/3 Interval
(Fig. 192, 193, 194, 195)
Form: Ring basket.
Number of specimens: 6.
Type of specimens: Complete.

Technique and Comments: With the exception of interval, ring baskets of this type are identical in basic configuration and construction to Type XXI ring baskets. In all but one case, selvage treatment also is similar. In this variant, single elements pass over each other in a 3/3 interval. Shifts include examples of 3/1/3, 3/2/3, 3/4/3, 3/5/3, 3/6/3, 3/5/2/3, 3/2/3/1/3, 3/2/1/2/3 and 3/2/3/1/1/2/3 intervals. In five cases, one or more of these shifts is regularly employed to produce patterns on the bases of the baskets. These patterns include three plain meanders and two plain concentric diamonds (cf. Morris and Burgh 1942: Fig. 10 e, f, g). In three cases, the ring is *Rhus* sp. with cortex and in two cases *Salix* sp. with cortex. The wooden ring is missing in the remaining specimen. Selvage treatment on five specimens is as described for Type XXI ring baskets. The selvage is folded to the outer surface on three specimens and folded to the interior surface on three specimens. In four specimens, the folded selvage is secured by a single circuit of simple 2-ply twining with unspun wefts. Two of these circuits are S-twist and two are Z-twist. The sel-

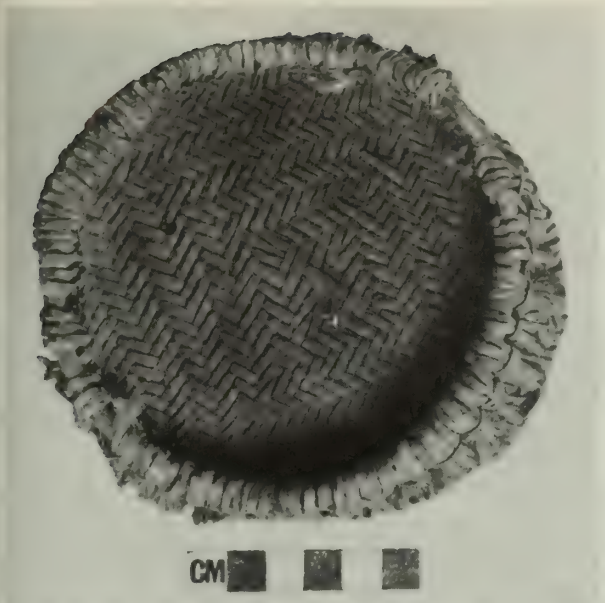


Figure 192. Complete Type XXII (180° self selvage) ring basket with plain concentric diamond design; twill plaiting, 3/3 interval; concave surface.

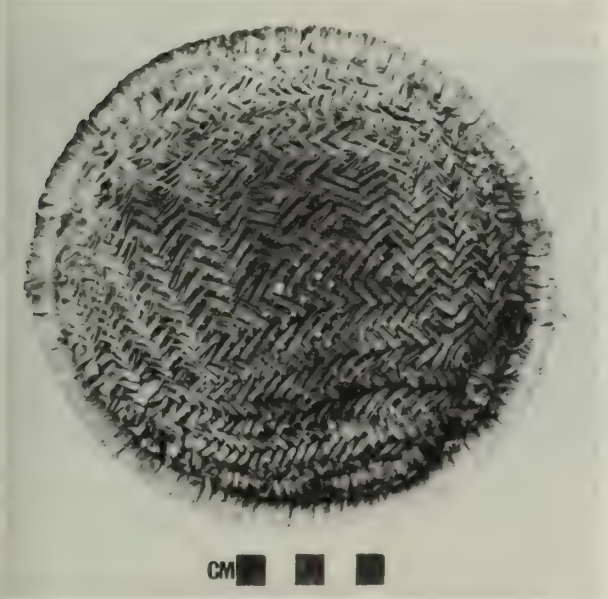


Figure 193. Complete Type XXII (180° self selvage) ring basket with plain concentric diamond design; concave surface.

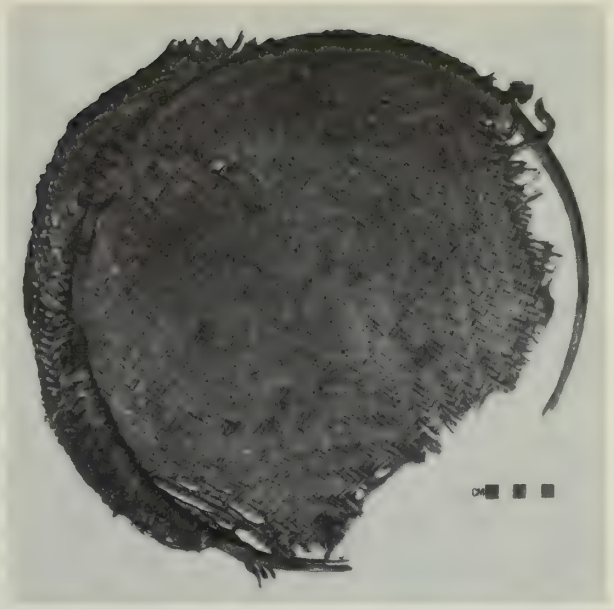


Figure 194. Type XXII (180° self selvage) ring basket fragment with plain meander design; concave surface.

vage of one specimen is secured with a simple twining circuit of 2-ply Z-spun S-twist cordage wefts. Two to four elements are engaged at each weft crossing. Weft rows are terminated by tucking the exhausted wefts under the initial weft crossing. The selvage of the sixth specimen is a somewhat unusual variant of the 180° type: terminal elements are folded to the exterior of the basket at a 180° angle and secured in groups of three by a single circuit of simple 2-ply S-twist twining with S-spun Z-twist cordage wefts. While two of the terminal elements in each group are clipped after binding, the third element is plaited with the corresponding element in the adjacent set in a 1/2 interval. After two such intervals, the elements are folded 140° toward the rim and plaited for two more 1/2 intervals. The elements are then clipped about 2 mm below the wooden ring. The net result is a 180° self selvage which is finished with a 90° self selvage, presumably for decorative effect. The sample includes four shallow bowls and two shallow trays. All specimens are unmended, unpitched and not naturally watertight. Three specimens exhibit moderate wear on both surfaces and one specimen has moderate to heavy wear on the interior surface only. One of the worn specimens also is stained. Two specimens exhibit no wear.

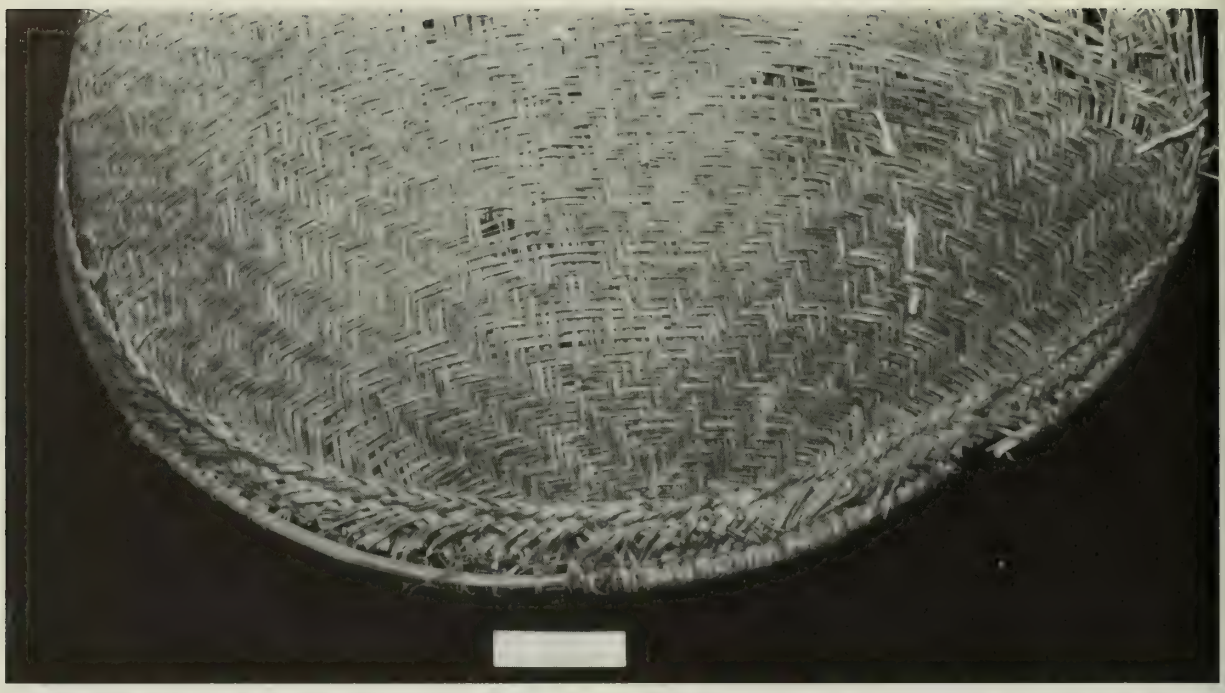


Figure 195. Type XXII (180° self selvage) ring basket fragment; convex surface. Note combination of 180° and 90° selvages.

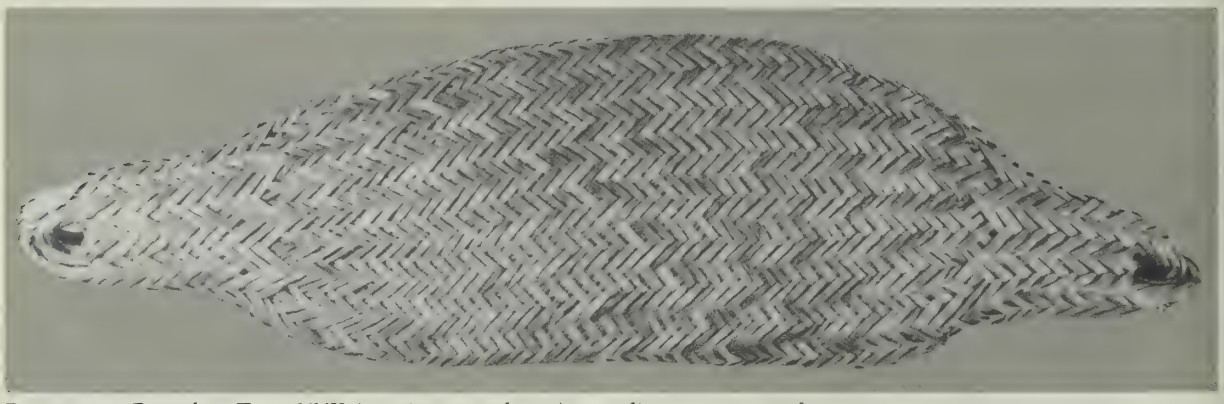


Figure 196. Complete Type XXII (continuous selvage) tumpline; convex surface.

Measurements (all specimens): Range in diameter of plaiting elements, 2.8–8.7 mm; mean diameter of plaiting elements, 4.9 mm; range in angle of crossing of plaiting elements, 90°–110°; mean angle of crossing of plaiting elements, 96.8°; range in diameter of ring, 5–16 mm; mean diameter of ring, 9.24 mm; range in diameter of binding circuit, 2–3.1 mm; mean diameter of binding circuit, 2.53 mm; range in number of elements bound at each weft crossing, 2–4; mean number of elements bound at each weft crossing, 2.6.

Measurements (individual specimens): Container 1—maximum diameter of rim, 298 mm; maximum depth, 100 mm. Container 2—maximum diameter of rim, 160 mm; maximum depth, 70mm. Container 3—maximum diameter of rim, 150 mm; maximum depth, 70 mm. Container 4—maximum diameter or rim, 110 mm; maximum depth, 30 mm. Container 5—maximum diameter of rim, 110 mm; maximum depth, 20 mm. Container 6—maximum diameter of rim, 440 mm; maximum depth, 50 mm.

Type XXII (continuous selvage): Twill Plaiting, 3/3 Interval (Fig. 196)
Form: Tumpline.
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: The complete Type XXII tumpline is at once the finest representative of its form group recovered at Antelope House and one of the finest ever recovered in the Greater American Southwest. Unlike the Type XXI tumpline, which is composed of multiple plaited segments, the Type XXII specimen is a one-piece construction. The method of manufacture is somewhat analagous to the Types XXI and XXII truncated cylinder pot rests. The body of the tumpline is a flattened cylinder produced by continuous radial plaiting with single elements in a basic 2/2 interval. Shifts include examples of 3/1/3 and 3/2/3 intervals. The 3/1/3 intervals are employed exclusively toward both ends of the specimen in order to reduce its overall width. The end loops are produced by folding terminal elements at a 180° angle into the interior of the tumpline. These elements are intentionally left quite long to provide additional mass, or padding, to the interior of the tumpline. The specimen is undecorated, unmended, unpitched and not naturally watertight. Wear patterns are restricted to very slight wear on the margins of the body of the tumpline. Slight staining is apparent on limited portions of the convex, or exterior, surface.

Measurements: Mean diameter of plaiting elements, 4.5 mm; mean angle of crossing of plaiting elements, 95°; maximum interior diameter of end loops, 12.4 mm; length, 5.36 mm; width, 142 mm; thickness (at midpoint of body), 19.8 mm.

Type XXIII (90° self selvage): Twill Plaiting, 4/4 Interval
Form: Matting.
Number of specimens: 1.
Type of specimens: Fragment.

Technique and Comments: Single elements pass over each other in a 4/4 interval. No shifts are present. Selvage on one extant margin has terminal elements folded back at a 90° angle and replaited into the body of the mat. Selvage on the other extant margin has alternate elements folded to opposite sides of the mat, producing a double 90° edge. The specimen is undecorated, unpitched, unmended and not naturally watertight. Heavy wear is present on both surfaces.

Measurements: Mean diameter of plaiting elements, 5 mm; mean angle of crossing of plaiting elements, 90°.

Type XXIII (180° self selvage): Twill Plaiting, 4/4 Interval
Form: Ring basket.
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: With the exception of interval, ring baskets of this type are identical in basic configuration and construction to Types XXI and XXII ring baskets. Selvage treatment also is similar. In this variant, single elements pass over each other in a 4/4 interval. Shifts include examples of 4/1/4, 4/2/4, 4/3/4, 4/6/4, 4/7/4, 4/8/4, 4/3/5/4/2/4 and 4/2/1/2/1/2/4 intervals. Standard 4/4 intervals predominate in the center of the basket, while 4/3/4 and 4/2/4 shifts are most common on the walls and near the rim, respectively. Shifts are principally employed in the production of a plain meander design on the center of the basket (cf. Morris and Burgh 1942: Fig. 10f, g). The ring of this specimen is *Salix* sp. with cortex. Selvage treatment has terminal elements folded at a 180° angle to the exterior of the basket. The ends of these elements are secured by a single circuit of simple 2-ply unspun S-twist twining, which engages two plaiting elements at each weft crossing. The twining circuit is terminated by tucking the exhausted wefts under the initial weft crossing. The specimen apparently is a shallow bowl and is unmended, unpitched and not naturally watertight. Moderate to heavy wear is present on both surfaces. The specimen is badly distorted through use or the circumstances of interment and the exterior surface is reddened, presumably by fire.

Measurements: Range in diameter of plaiting elements 1.9–5.5 mm; mean diameter of plaiting elements, 3.7 mm; mean angle of crossing of plaiting elements, 90°; mean diameter of ring, 9 mm; mean diameter of binding circuit, 3 mm; mean number of elements bound at each weft crossing, 2; maximum diameter of rim, 370 mm; maximum depth, N.A. (specimen is distorted).

Miscellaneous Fiber Constructions

The 42 specimens herein labeled miscellaneous fiber constructions are allocated to 11 more or less arbitrary categories, which are described below without numerical prefixes. Table 144 shows the distribution of miscellaneous constructions by category, raw material, period and provenience.

Plaiting: Variable Interval (Fig. 197)
Form: Perforated handle(?).
Number of specimens: 1.
Type of specimen: Complete.

Technique and Comments: This specimen is composed of a single *Yucca angustissima* stalk, which is bifurcated for some one-half of its length. Each half segment is further subdivided into five sections, which constitute the basic plaiting elements. The five elements of each section are more or less randomly plaited in 1/1, 1/2 and 2/2 intervals and possess very irregular 90° self type side selvages. The half segments are jointed to form a loop, or aperture, by knitting the loose ends of the plaiting elements with a series of six square knots. The lower limit of the initial bifurcation is reinforced with an overhand knot. The specimen is undecorated and unmended. Wear patterns are restricted to slight charring on one surface. The function of this unique specimen is unknown, although its general configuration suggests that it may represent a handle of some sort.

Measurements: Range in diameter of plaiting elements, 1.6–4.5 mm; mean diameter of plaiting elements, 3.05 mm; mean angle of crossing of plaiting elements, 77°; maximum interior diameter of loop, 55 mm; minimum interior diameter of loop, 35 mm; length 109 mm; maximum width, 25 mm.

Plaiting: Unknown Interval
Form: Matting.
Number of specimens: 2.
Type of specimens: Fragments.
Number of individual mats represented: 2.

Technique and Comments: Single elements pass over each other in an unknown interval. The presence or absence of shifts is not discernible. The configuration of the plaiting elements suggests selvage treatment may have been of the 90° self type. The specimens are undecorated, unmended, unpitched and not naturally watertight. Both specimens exhibit heavy wear and are disintegrating.

Measurements: Mean diameter of plaiting elements, 6 mm; mean angle of crossing of plaiting elements, N.A.

Plaiting: Unknown Interval
Form: Plaited band.
Number of specimens: 1.
Type of specimens: Fragments.

Technique and Comments: Single elements pass over each other in an unknown interval. The original number of elements, as well as the presence or absence of shifts, is not discernible. The configuration of the plaiting elements suggests side selvage was of the 90° self type, while end selvage may have been of the 180° self type. The specimen exhibits heavy wear and is disintegrating.

Measurements: Mean diameter of plaiting elements, 7 mm; mean angle of crossing of plaiting elements, N.A.; width, 27.8 mm.

Plaiting: Unknown Interval
Form: Ring baskets.
Number of specimens: 2.

Technique and Comments: Single elements pass over each other in an unknown interval. The presence or absence of shifts is not discernible. The ring is decorticated *Salix* sp. in one specimen and is absent in the other. Selvage treatment of the specimen with the ring has terminal elements folded at a 180° angle to the exterior of the basket. The elements are secured by a single circuit of simple 2-ply unspun S-twist twining. The method of terminating the twining is unknown. Both specimens are undecorated, unmended, unpitched and not naturally watertight. Vessel configuration is not discernible. Both specimens exhibit heavy wear on all surfaces and are disintegrating. One is stained and the other has a human coprolite and husk of *Zea mays* adhering to one surface.

Measurements: Range in diameter of plaiting elements, 6–8 mm; mean diameter of plaiting

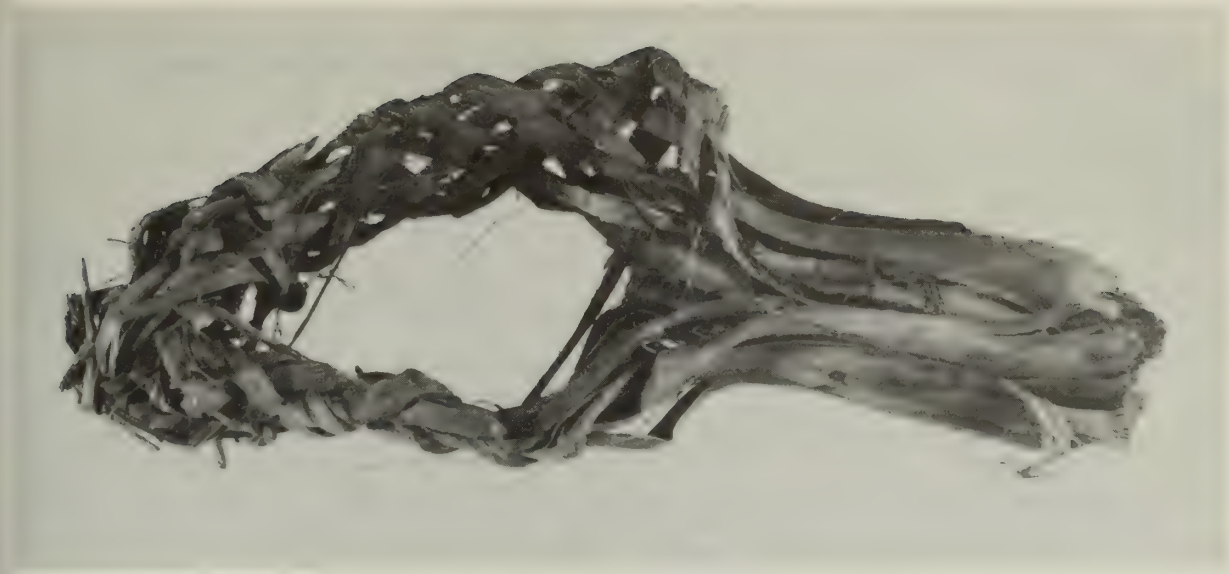


Figure 197. Complete perforated handle (?) of variable interval plaiting.

elements, 7 mm; mean diameter of ring, 9 mm; mean number of elements bound at each weft crossing, 3.

Plaiting: Unknown Interval
Form: Open weave bag.
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: A series of single elements is loosely and irregularly plaited together in no particular pattern or interval. The plaiting is so loose that a circuit of single-ply unspun *Yucca baccata* cordage (mean diameter, 2.7 mm) is employed to bind or reinforce the plaiting elements. The cordage is irregularly looped around the plaiting elements and is initiated and terminated with square knots. There is no selvage. The specimen is undecorated, unmended and not naturally watertight. Heavy wear is present on the outer surface and a lump of *Pinus* sp. resin adheres to the concave surface of the bag.

Measurements: Range in diameter of plaiting elements, 6.1–19.3 mm; mean diameter of plaiting elements, 12.7 mm; mean angle of crossing of plaiting elements, 80°.

Flat Plaited Rectangles
Number of specimens: 3
Type of specimens: Complete.

Technique and Comments: Two varieties of flat plaited rectangles are represented at Antelope House. In the sole example of the first variety, two single elements are crossed at right angles and irregularly bound at their juncture with a circuit of single-ply unspun *Yucca angustissima* cordage (mean diameter, 2.35 mm). The cordage is terminated with a square knot. Each element is then folded back on itself at a 180° angle and plaited for one 1/1 interval. In the second variety, four single or, in one case, double elements are plaited for one 1/1 interval. Each element is then folded back on itself at a 180° angle and plaited for another 1/1 interval. All rectangles are undecorated, unmended, unpitched and not naturally watertight. All specimens have moderate to heavy wear on both surfaces. The function of these rectangles is unknown.

Measurements: Range in diameter of plaiting elements, 3.5–14.60 mm; mean diameter of plaiting elements, 7.1 mm; mean angle of crossing of plaiting elements, 90°; range in length, 17–130 mm; mean length, 77.5 mm; range in width, 15–95 mm; mean width, 63.5 mm.

Table 144. Distribution of fiber constructions by category, raw material, period and provenience.

Key
The first Arabic numeral indicates miscellaneous category; the set of letters designates raw materials; the second Arabic numeral represents number of specimens.

Categories
1. Plaiting: Variable Interval
2. Plaiting: Unknown Interval
3. Flat Plaited Rectangles
4. Zigzag Doodles
5. Patches
6. Fiber Wrapped Twig Construction
7. Hoops: Figure Eight Stitch
8. Figure Eight Doodle
9. Fiber Wrapped Rod
10. Latticework Constructions
11. Construction Material

	South Area		*South Room Block*											
	South Plaza	*South Plaza Floor 1*	*Tower Corridor*	*Tower Corridor Floor 3*	*Room 1*	*Room 2*	*Room 21*	*Room 21 Pit*	*Room 21 Floor 2*	*Room 21 Floor 3*	*Room 23*	*Room 29 Floor 3*	*Room 30*	*Room 30 Floor 1*
BMIII														
PI														
PII							11-PY-1							
EPIII	10-SYb-1					2-Ya-1					11-Yb-1			
MPIII		3-Ya-1						7-SS-1					4-Zm-1	
LPIII		7-SS-1	2-Yb-1 7-SS-1	10-SYb-1	2-S-1 5-Yb-1	11-T-1			1-Ya-1 2-Yb-1 3-Yb-1	7-SS-1	5-Yb-1 7-SS-1	11-PYb-1 11-SYa-1		7-RS-1
Navajo	4-Zm-1													
Unknown	6-RRYb-1													
TOTALS	3	2	2	1	2	2	1	1	3	1	3	2	1	1

Central Room Block					*North Room Block*						*North Area*	
Kiva B	*Kiva B Annex Floor 1*	*Room 36 Floor 5*	*Room 42*	*Room 50 Floor 1*	*Room 5*	*Room 16*	*Room 18*	*Room 18 Floor 2*	*Room 41 Floor 2*	*North Terrace*		**Totals**
												0
										2-S-1		1
												1
8-R-1												4
												3
9-S-1 2-Yb-1	7-SS-1	7-SS-2	7-SS-1	11-PYb-1			11-SYb-1		7-SS-1	3-Yb-1 11-Ya-1	7-SS-1	28
					7-SS-1			7-RS-1				3
						7-SYb-1						2
3	1	2	1	1	1	1	1	1	1	3	1	42



Figure 198. Zigzag doodle.

Zigzag Doodles (Fig. 198)
Number of specimens: 2.
Type of specimens: Complete(?), 1; fragment, 1.
Number of individual doodles represented: 2.

Technique and Comments: These constructions are the products of a multistep folding and twisting process. Initially, a single element is folded back on itself at a 180° angle. One end of this folded element is then folded at a 90° angle and twisted in a counterclockwise direction. The other end is similarly folded and twisted in a clockwise direction *over* the initial 90° fold. At this point, a second single element of the same length as the first is inserted into the loop formed by the initial 180° fold and the 90° folding and twisting process is repeated in both ends of the second element. The loose ends of the first folding and twisting series are secured by the second and so on until the construction is complete. These specimens are undecorated, unmended, unpitched and not naturally watertight. There are no wear patterns. The function of these specimens is unknown.

Measurements: Range in width of elements, 23.3–35 mm; mean width of elements, 29.15 mm; range in length, 38.2–145 mm; mean length, 97.6 mm.

Patches
Number of specimens: 2.
Type of specimens: Complete(?).
Number of individual patches represented: 2.

Technique and Comments: Both of these somewhat amorphous items appear to be mends or patches for plaited baskets. The first is a single unspun untwisted element, irregularly wrapped by two similar elements and secured with two square knots. The second is a segment of twill plaiting with single elements in a 2/2 interval. There is no selvage. "Warps," or bunches of three to four *Yucca baccata* leaves, have been added to one surface of the plaiting by several irregular circuits of simple 2-ply unspun S- and Z-twist twining. One of the twining circuits is terminated with a square knot. Both specimens are undecorated, unpitched and not naturally watertight. These patches may have been used to reinforce tears or to fill holes in heavily worn containers.

Measurements: Patch 1—range in diameter of plaiting elements, 2.5–8 mm; mean diameter of plaiting elements, 5.25 mm; length, 40 mm; width, 30 mm. Patch 2—range in diameter of plaiting elements, 2.8–5 mm; mean diameter of plaiting elements, 3.9 mm; mean angle of cross-

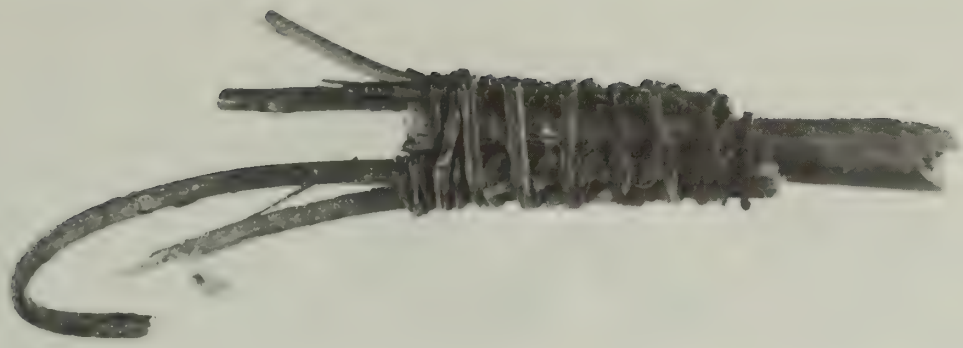


Figure 199. Fiber-wrapped twing construction.

ing of plaiting elements, 90°; mean diameter of warps, 9.1 mm; mean diameter of wefts, 2.7 mm; mean gap between weft rows, 0; warps per centimeter, 1; wefts per centimeter, 4; length, 55 mm; width, 35 mm.

Fiber-Wrapped Twig Construction (Fig. 199)
Number of specimens: 1
Type of specimen: Fragment.

Technique and Comments: Two decorticated *Rhus* sp. twigs are bent back onto themselves at a 180° angle to form loops. Each loop is then bound at the open end, or base, with multiple circuits of single-ply unspun *Yucca baccata* cordage (mean diameter, 1.6 mm). One twig loop is wrapped with five circuits of cordage and the other is wrapped with seven. In both cases, wrapping direction is left to right. These two constructions are in turn affixed to opposite sides of one end of a decorticated *Rhus* sp. rod by another series of single-ply unspun *Yucca baccata* wrapping stitches (mean diameter, 1 mm). There are eight circuits of wrapping stitches and the work direction is left to right. The twig loops are arranged parallel to the central rod and the closed ends of the loops extend beyond the ends of the rod. The specimen is undecorated and unmended. Heavy wear is present on all surfaces and both twig loops, as well as the central rod, are fractured.

Measurements: Mean diameter of central rod, 6.2 mm; mean diameter of loop twigs, 15.5 mm; length of extant construction, 75.9 mm.

Hoops: Figure-8 Stitch (Fig. 200, 201)
Number of specimens: 15.
Type of specimens: Complete, 1; fragments, 14.
Number of individual hoops represented: 14.

Technique and Comments: A stacked foundation, consisting of two whole, decorticated rods or, in one case, a decorticated rod and a *Yucca baccata* fiber bundle, is sewn with figure-8 wrapping stitches. The rods are formed into closed circular to oval hoops and the stitching completely circumscribes the foundation. There is a gap between the stitches exposing the rods. Work direction includes seven examples of left to right wrapping and one each of right to left and mixed wrapping. Six specimens are too fragmentary to discern wrapping direction. New stitches are added by simply encircling the foundation one to four times before initiating the figure-8 stitch pattern. On one specimen, a coiling splice is used in which the exhausted stitch is clipped short and the end of the new stitch is bound under. All specimens are undecorated, unmended, unpitched and not naturally watertight. All specimens exhibit moderate to heavy wear and five are worn to the point of disintegration. These hoops may have functioned as rims on some sort of container or as cradle supports (cf. Hough 1919: Pl. 25, 2; Pl. 49, 4).

Measurements: Range in diameter of rods, 1.75–5.30 mm; mean diameter of rods, 3.63 mm; range in width of stitches, 1.4–3.25 mm; mean width of stitches, 2.23 mm; range in gap between stitches, 0–6.75 mm; mean gap between stitches,



Figure 200. Fragment of hoop, figure-8 stitch.



Figure 201. Fragment of hoop, figure-8 stitch.



Figure 202. Complete latticework construction; Specimen 1, concave surface.

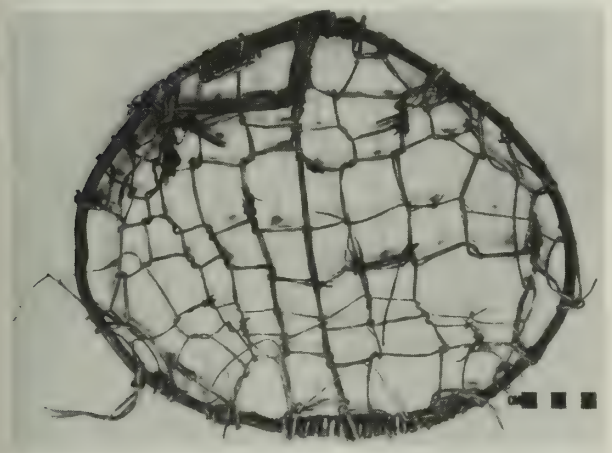


Figure 203. Complete latticework construction, Specimen 2, concave surface.

1.93 mm; range in stitches per centimeter, 2–5; mean stitches per centimeter, 3; maximum diameter (complete specimen), 80 mm.

Figure-8 Doodle
Number of specimens: 1.
Type of specimen: Complete(?).

Technique and Comments: Two decorticated *Rhus* sp. elements are X-crossed and the ends of each element are linked by figure-8 *Rhus* sp. stitches. Work direction alternates from clockwise to counterclockwise and there are two complete circuits of stitches. The specimen is undecorated and unmended. There are no wear patterns. The function of this construction is unknown.

Measuremnts: Mean diameter of elements, 3 mm; length, 45 mm; width, 33 mm.

Fiber-Wrapped Rod
Number of specimens: 1.
Type of specimen: Fragment.

Technique and Comments: A tapered, decorticated, bilaterally split rod is wrapped on its narrow end with two lengths of single-ply unspun cordage. Both lengths of cordage lie parallel to the rod and each engages the same end with a single complete wrapping circuit. The specimen is unmended and undecorated. Its function is unknown.

Measurements: Mean diameter of rod, 11.35 mm; mean width of stitches, 2.62 mm.

Latticework Constructions (Fig. 202, 203)
Number of specimens: 2.
Type of specimens: Complete(?).

Technique and Comments: A foundation consisting of one or two whole rods is bent into an oval hoop or ring and is used to support an open weave, latticework center. In the first specimen, the hoop is a single, partially decorticated *Salix* sp. rod, which is secured at the point of juncture, or overlap, by eight circuits of single-ply unspun wrapping stitches. Work direction on the first four wrapping circuits is left to right and is reversed on the second set of four. Both ends of the wrapping stitch are secured by a single square knot. The latticework of the first specimen is constructed of a single-ply unspun "continuous" element, which initially makes a series of traverses across the maximum diameter of the hoop at about 1.6 cm intervals. The element wraps the foundation on the end of each circuit. After the initial set of circuits is complete, the element is then drawn across them at right angles, engaging each preexisting circuit with a wrapping stitch. After each complete crossing, the element wraps the hoop before initiating another circuit. This process produces an irregular diamond-shaped lattice. The continuity of the

active weaving element is maintained by splicing with square and figure-8 knots. At five points along the hoop of this specimen, single-ply unspun *Yucca baccata* elements have been affixed with double half-hitches. A length of single-ply unspun *Yucca baccata* cordage (mean diameter, 1.47 mm) circumscribes the entire hoop and is bound to it by the latticework.

The hoop of the second specimen is composed of *Salix* sp. rods with cortex, the junctures of which are bound with 15 and 21 circuits of single-ply unspun wrapping stitches, respectively. Direction of wrapping is right to left and the ends of the stitches are bound under. The latticework of this specimen is constructed of single-ply unspun elements, as is that of the first, but the method of manufacture differs somewhat. A "continuous" single-ply unspun element initially forms a rough hexagram by systematically engaging a series of points along the interior of the hoop. The active end of this element then bisects the hoop and is secured with a square knot to the foundation. A second single-ply unspun element is attached to the initial element near the point of bisection of the hoop. This element then wraps the foundation and proceeds in a counterclockwise direction, engaging with a wrapping stitch all traverses of the initial element. After each series of engagements, the second element wraps the foundation, creating a series of loose clove hitches. This process is repeated until the diamond-shaped lattice is complete. New elements are added to the lattice by splicing with square knots. Along the edge of the hoop, a single-ply unspun element has been suspended in a series of overhand nooses at intervals of 5 to 9 cm. This noose construction, which originally circumscribed the rim, apparently was affixed to other, now missing, elements. Yet another enigmatic element is bound to the hoop. This construction is composed to two unspun *Yucca baccata* fibers, which are wrapped by a third such fiber and secured to the rim by a pseudoslip knot. While only one such structure is extant, there may have been a series of them spaced along the hoop.

Both latticework constructions are undecorated. The lattices of both are mended with numerous square knots. Light to moderate wear is pronounced in the hoops and lattice "centers" of these constructions. While these items could represent open weave trays, it is more likely that they are "bottoms" of some variety of collapsible container.

Measurements: Specimen 1—mean diameter of foundation, 6.90 mm; range in diameter of latticework elements, 1.65–3 mm; mean diameter of latticework elements, 2.32 mm; maximum diameter of hoop, 160 mm. Specimen 2—range in diameter of foundation, 7.8–9.15 mm; mean diameter of foundation, 8.57 mm; range in diameter of latticework elements, 2.3–2.75 mm; mean diameter of latticework elements, 2.52 mm; maximum diameter of hoop, 336 mm.



Figure 204. Construction material; **Phragmites** *sp. mat "package" bound with cordage.*

Construction Material (Fig. 204)
Number of specimens: 8.

Technique and Comments: Included here is a variety of materials apparently used in the con-

struction of one or another type of basketry. The sample includes one bunch of pitched *Yucca baccata* elements; one length of split *Yucca angustissima;* one bunch of *Y. baccata* and *Salix* sp. elements; one bunch of mixed *Yucca angustissima* and *Scirpus* sp. elements; one bunch of *Phragmites* sp. rods and *Yucca baccata* elements; one bunch of *Typha* sp. leaves; and two packages of *Phragmites* sp. rods bound with cordage. The first of these packages contains five bunches of rods numbering 5, 5, 6, 7 and 17 specimens, respectively. A continuous length of 2-ply unspun *Yucca baccata* cordage engages each group of rods in succession with a double overhand knot. The second package has four bunches of rods numbering 1, 1, 1 and 2 specimens, respectively. These rods are bound with 2-ply Z-spun S-twist cordage wefts. Twining is initiated on this package with a continuous weft selvage and is terminated with a double overhand knot.

Measurements (fiber bundles and individual elements): None taken.

Measurements: Package 1—range in length of rods, 270–305 mm; mean length of rods, 292.5 mm; range in diameter of rods, 2.9–4.1 mm; mean diameter of rods, 3.45 mm; mean diameter of cordage, 2.45 mm. Package 2—range in length of rods, 250–320 mm; mean length of rods, 301 mm; mean diameter of rods, 5.13 mm; mean diameter of wefts, 4.75 mm.

Internal Correlation

A synopsis and assessment of the results of our analysis are presented below by basketry subclass or residual category.

Twining

Twining, represented by five structural types, accounts for some 5.03 percent of the Antelope House basketry sample. Each twining specimen apparently represents a separate vessel or receptacle. The distribution and frequency of twining types is presented in Table 136 by raw material, period and provenience.

Technology

Of the five twining types represented at Antelope House, four are simple twining variants and one is diagonal. Collectively, simple twining varieties account for 96.77 percent of the twining sample, with the single diagonal type accounting for the remaining 3.23 percent. Of the four simple twining types, Type IV (Open Simple Twining, S-Twist Weft) is the most common, representing 77.41 percent of the total twining assemblage. The remaining simple twining types are numerically insignificant.

Warps. Ninety percent of the warps in the simple twining types are unspun elements; the example of diagonal twining also has unspun warps. Simple twining warps are single elements in 11 cases and multiple elements functioning as a single warp unit in 16. The multiple element warp units include two examples of doubled, eight examples of trebled and six examples of quadrupled warps. The example of diagonal twining has single element warps. The three Type II (Close Simple Twining, S-Twist Weft) sandal fragments (which technically are not basketry) provide the only examples of spun warps in the Antelope House sample. These warps are 2-ply Z-spun S-twist cordage.

Method of Starting. Most of the Antelope House twining specimens are fragmentary portions of matting, making it difficult to determine the exact method of starting. The few specimens with selvage suggest that twining was begun at one corner of the mat and proceeded, either in discrete noncontinuous weft courses or in continuous weft courses, to the opposite end of the mat. A similar method is inferred for the sandal fragments. The Type I (Close Simple Twining, Z-Twist Weft) petate has a true center, produced by radial twining on crossed warps. The Type IV (Open Simple Twining, S-Twist Weft) bag has no center, as it is composed of a single *Yucca* sp. stalk.

Selvages. Few twined specimens with selvage were recovered from Antelope House, and the sample may not be representative of the full repertoire of finishing techniques used at the site. End selvages include three examples of 180° warp folds followed by truncation; one example of warp truncation without folding; one example of three-element braid produced by folding and plaiting terminal warp elements in a 1/1 interval; and one example of a twilled rim, in which terminal warps are folded and plaited in a 2/2 interval. There is still less variety in the side selvages, which include three examples of continuous wefts and three examples of termination by overhand knot.

Splices. Only one splice is present. A Type II (Close Simple Twining, S-Twist Weft) sandal fragment has new wefts inserted by an overhand knot splice with the exhausted weft course. This splicing technique probably was also the standard method of introducing new wefts in all forms of twined matting.

Mending and decoration. None of the twining specimens are decorated and only one is mended. The frayed wefts of a Type III (Open Simple Twining, Z-Twist Weft) mat may have been secured or reinforced with square and double overhand knots. The lack of mending in the twining assemblage also is found in the other subclasses of basketry.

Form and Function. All mats appear to have been rectangular in plan, with no obvious top or bottom side. Moderate to heavy wear on one or both surfaces attests the extensive use of these specimens, either as floor coverings or as "flattened receptacles," upon which a variety of items may have been temporarily placed or stored. The presence of wear on only one surface of several mats strongly suggests that these items were not turned over until they had been heavily worn on one side. This premise is reinforced by several specimens which are heavily worn on one surface and lightly to moderately worn on the other. The general scarcity of any other twining forms at Antelope House may be directly related to the great popularity of plaiting and, to a lesser extent, coiling as the preferred basketry constructions. As might be expected in an assemblage dominated by matting, virtually all specimens are semiflexible to flexible and no specimens are pitched or naturally watertight.

Raw Materials: Five plant genera were employed in the production of twined basketry at Antelope House. Warps are made of *Scirpus* or, in descending order of preference, of *Typha, Yucca, Salix* or *Phragmites.* Method of preparation of *Scirpus* and *Typha* matting warp elements was restricted to immersion in water and occasional longitudinal splitting of the leaves to maintain uniform size. *Yucca, Salix* and *Phragmites* matting warps also were immersed, but are otherwise unmodified. *Yucca* cordage sandal warps were immersed, retted and spun, while *Yucca* petate and bag warps were immersed and longitudinally split to maintain uniformity of width. Wefts generally are made of *Yucca* (usually *angustissima*); *Scirpus* and *Typha* also were used. *Yucca* cordage wefts were immersed, retted and spun; all other *Yucca* wefts were immersed, but were otherwise unmodified. *Scirpus* and *Typha* wefts were immersed and occasionally were split longitudinally, but are otherwise unaltered.

Chronology

As Table 136 shows, twining is continuously represented at Antelope House from PI through Late PIII occupations, but it is a minority subclass, contributing scarcely more than 1 percent of the total basketry assemblage during any one period. The greatest relative incidence of twining is during Late PIII, when it accounts for but 1.1 percent of the total basketry sample. The earliest twining type at Antelope House is a single specimen of Type III (Open Simple Twining, Z-Twist Weft) ascribable to the PI occupation. This type recurs only once, in Late PIII. The next twining types to appear are II (Close Simple Twining, S-Twist Weft) and IV (Open Simple Twining, S-Twist Weft) in PII. Type V (Open Diagonal Twining, S-Twist Weft) is restricted to Early PIII. The only example of Type I (Close Simple Twining, Z-Twist Weft) is of unknown age. Over one-third (35.5 percent) of the total twining assemblage is of unknown or mixed age.

Warps. Multiple element unspun warps appear during PI and persist as the favored warp manipulation through Late PIII. Single element unspun warps first occur during Middle PIII and continue through Late PIII. Two-ply S-spun Z-twist cordage warps are restricted to PII and Middle PIII.

Wefts. Two-ply S-spun Z-twist cordage wefts, ascribable to the PI occupation, are the earliest at Antelope House. This weft manipulation recurs only once, in Late PIII. Two-ply Z-spun S-twist wefts appear in PII and constitute the principal weft medium through Late PIII. Unspun S-twist wefts are restricted to Middle PIII; unspun Z-twist wefts are of unknown age.

Selvages. Little information is available on the sequence of selvage treatments at Antelope House. Simple truncation, three-element braid and 2/2 twill are of unknown age. The only other extant end selvage, the 180° secured fold, is restricted to single occurences in PI, Middle PIII and Late PIII. Still fewer chronological data are available on side selvages. Overhand knot weft terminations occur only in Late PIII and continuous wefts are limited to PII. In light of the above, any con-

clusions as to the twining selvage sequence at Antelope House would be premature.

Form and Function. Matting, the predominant twining form at Antelope House, first appears in PI and persists throughout the remainder of the sequence. Non-matting forms occur sporadically from PII to Middle PIII.

Raw Materials. No particular trends are evident in the use of raw materials in twining manufacture through time. *Yucca* is employed throughout the Antelope House sequence. Because *Yucca* was used principally in the finely retted state for the production of cordage wefts, identification of species is difficult. It appears, however, that *Yucca angustissima* was employed more extensively than was *Y. baccata,* particularly during Late PIII. *Typha* occurs sporadically from PI through Late PIII and *Scirpus* was used more extensively than was *Y. baccata,* particularly during Late PIII. *Typha* occurs sporadically from PI through Late PIII and *Scirpus* was used extensively from PII to Late PIII, with a hiatus in Middle PIII. The incidence of *Phragmites* is restricted to Early PIII and the only occurrence of *Salix* is of indeterminate age.

Insufficient data are available to delineate the chronology of method of starting, splicing method or mending, and decorating techniques at Antelope House.

Internal Distribution and Relationships

The twining assemblage at Antelope House is differentially distributed. Sixty-four and a half percent of the twining assemblage was recovered from the South Area/South Room Block, 29 percent from the North Room Block/North Area. Only 6.5 percent of the sample is from the Central Room Block. Type IV (Open Simple Twining, S-Twist Weft) is the only twining type with pan-site distribution. Types II (Close Simple Twining, S-Twist Weft) and V (Open Diagonal Twining, S-Twist Weft) occur only in the South Area/South Room Block, and Type I (Close Simple Twining, Z-Twist Weft) is found only in the North Room Block/North Area. Type III (Open Simple Twining, Z-Twist Weft) occurs both in the Central Room Block and in the North Room Block/North Area.

PI twining is restricted to the North Room Block/North Area, while PII and Early PIII twined materials occur only in the South Area/South Room Block. Twining ascribable to Middle PIII is present in both the South Area/South Room Block and in the North Room Block/North Area. Late PIII twined wares have a pan-site distribution. Twining of unknown age is concentrated in the South Area and in the North Room Block/North Area.

Matting has a pan-site incidence. The non-matting forms are restricted to one or another of the major architectural units.

The major raw materials are more or less evenly distributed across the site. *Yucca* occurs in all architectural units, as do *Scirpus* and *Typha.* The less exploited plant resources, *Phragmites* and *Salix,* are restricted to the South Area and North Room Block, respectively.

The distribution of twining at Antelope House sheds little light on the socio-cultural milieu of the basket makers at the site. Because the sample is far too small and too fragmentary for detailed analysis of idiosyncratic manufacturing variables, examination or delineation of individual basket makers, groups of basket makers or "micro" basket weaving traditions through time is impossible for this segment of the basketry assemblage.

Coiling

Coiling, represented by 14 structural types, accounts for some 12.5 percent of the total Antelope House basketry sample. The 77 coiling specimens represent a minimum of 71 containers. The high ratio of containers to fragments is paralleled in the twining and plaiting assemblages and is somewhat unusual in dry sites from western North America. We are quite certain, however, that the tally is accurate. Special care was taken to match all fragments which could possibly have been portions of the same container, mat, etc., allowing for structural variation of fragments derived from different areas of a basket or other receptacle (e.g., wall, rim or base).

The distribution and frequency of coiling types is presented in Table 137 by raw material, period and provenience.

Technology

Of the 14 coiling types represented at Antelope House, 13 are close coiling variants and one is open coiling. Collectively, close coiling varieties account for 98.7 percent of the total coiling sample and for 98.59 percent of the probable

total of coiled containers. The sole open coiling type constitutes the remaining 1.3 percent and 1.41 percent.

Foundations. For discussion purposes, the close coiling from Antelope House may be lumped into three major categories: "single" rod types and allied variants, stacked foundation types and bunched foundation types. The "single" rod category includes Types VI (Bundle Foundation, Stitch Type Unknown), VII (Whole Rod Foundation, Interlocking Stitch), VIII (Whole Rod Foundation, Non-Interlocking Stitch), IX (Two Rod Horizontal Foundation, Non-Interlocking Stitch), X (Rod with Lateral Bundle Foundation, Non-Interlocking Stitch) and XIX (Open Coiling, Whole Rod Foundation, Intricate Stitch). These types may be lumped together because in all cases a single foundation element or its functional equivalent is employed in the manufacturing process and, more importantly, is manipulated by the weaver in precisely the same fashion.

The stacked foundation category includes Types XI (Two Rod Stacked Foundation, Non-Interlocking Stitch), XII (Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch); and XIII (Two Rod and Bundle Stacked Foundation, Non-Interlocking Stitch), all of which employ a vertical arrangement of foundation materials.

The bunched foundation category includes Types XIV (Two Rod and Welt Bunched Foundation, Non-Interlocking Stitch), XV (Three Rod Bunched Foundation, Non-Interlocking Stitch), XVI (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch), XVII (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch) and XVIII (Five Rod Bunched Foundation, Non-Interlocking Stitch). All foundation elements in this category are arranged in a triangular pattern. As a unit, these types account for 53.24 percent of the total coiling sample and for 49.79 percent of the probable total of containers. Within this category, Types XVI and XVII (both of which have identical Two Rod and Bundle Foundations) account for 53.52 percent of the total coiling sample and for 45.07 percent of the containers. The remaining bunched foundation coiling types are numerically insignificant.

The five "single" rod types account for 40.25 percent of the total coiling sample and for 43.71 percent of the probable total of containers. Within this grouping, Type VII is most common, accounting for 33.76 percent of the coiling sample and for 36.61 percent of the containers. The remaining "single" rod types are numerically inconsequential.

The stacked foundation types represent only 5.19 percent of the total coiling sample and 5.63 percent of the containers.

Stitches. Both simple and intricate stitch types are represented at Antelope House. Simple stitch types are by far the most common, accounting for almost 79 percent of both the total coiling assemblage and the probable total of containers. Significantly, only two of the major simple stitch types, interlocking and non-interlocking, are present. Stitches intentionally split on the work, non-work or both surfaces are absent. Non-interlocking stitches predominate over interlocking stitches, both in percentage of the total simple stitch sample (61.66/37.33) and in percentage of simple single stitch containers (59.50/40.50).

Although intentionally split stitches are not present at Antelope House, accidental splitting of the stitch on one or both surfaces is common. Accidental splitting is easily distinguished from intentional splitting by its irregularity and its generally haphazard appearance.

In virtually all of the non-bunched foundation coiling types, stitches wrap, rather than pierce, the foundation, The reverse situation generally prevails in the bunched foundation types, notably in Type XVII. Wrapping stitches occasionally are used in the bunched foundation types as expansion stitches, but double stitches were preferred for this purpose.

Gaps between the stitches, which expose the foundation, are found in most Antelope House coiling types. With the exception of Type XIX, these gaps are generally very narrow and clearly are not intentionally produced.

The sole example of intricate stitches at Antelope House is found in Type XIX.

Centers. Twenty-five complete or fragmentary specimens with starts or centers intact were recovered. Of these, 17 (68 percent) are continuous coil, five (20 percent) are reinforced continuous coil, and three (12 percent) are flattened continuous coil or oval. Two of the 17 continuous coil centers have central apertures. As 100 percent of the centers are one or another variation of continuous coil, it is more than reasonable to assume that this type of start was standard.

Rims. The Antelope House coiling sample includes 15 rim fragments, 11 (73.33 percent) of which are of the self type and two (13.33 percent) of which are false braid in a 2/2 interval. The remainder include one (6.66 percent) variation of the normal self type, in which the interstices between the terminal row of construction stitches have been filled with a circuit of wrapping stitches, and a self rim, the last 61.5 mm of which is finished in 1/1 false braid. The high proportion of self rims to all other types shows this finish to be the most common selvage treatment at Antelope House.

Work Surface. All tray or very shallow bowl fragments from Antelope House are worked on the concave surface; all deeper, steep-sided bowls and carrying baskets are worked on the convex surface. This is standard practice not only among the Anasazi, but also in most other basketmaking populations of North America.

Work Direction. Seventy-one of the specimens, representing 92.2 percent of the total sample and 91.54 percent of the probable total of containers, are worked from right to left; three of the specimens, representing 3.8 percent of the sample and 4.22 percent of the containers, are worked from left to right. Work direction on the remainder of the coiling assemblage is not discernible. The predominance of right-to-left work direction at Antelope House conforms to standard Anasazi practice.

Splices. Splices are one of the most, if not the most, diagnostic attributes in coiled basketry. Because no two individuals ever execute splices in precisely the same fashion, splices potentially have great utility in delineating macro or micro ethnic or social boundaries. At least five different kinds of splices were employed by the basket makers of Antelope House. The distribution of these is presented in Table 145 by coiling type. Also included are several splice combinations in which the manipulation of either the fag end or the moving end is unknown.

The most popular splice at Antelope House (26 occurrences) has both fag and moving ends bound under. It is the sole splicing technique in Types VIII (Whole Rod Foundation, Non-Interlocking Stitch), XI (Two Rod Stacked Foundation, Non-Interlocking Stitch) and XVI (Two Rod and Bundle Bunched Foundation, Interlocking Stitch), and accounts for 66.66 percent and 52 percent of the splices in Types VII (Whole Rod Foundation, Interlocking Stitch) and XVII (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch), respectively. The second most common splice has both fag and moving ends clipped short. This technique is the exclusive splicing method in Type XV (Three Rod Bunched Foundation, Non-Interlocking Stitch) and accounts for 5.5 percent and 21.05 percent of the splices in Types VII and XVII, respectively. The third most common splicing method has fag ends clipped short and moving ends bound under. The technique occurs only in Types VII and XVII, where it accounts for 22.22 percent and 5.26 percent of the respective splice totals. The remaining splice types are restricted to individual occurrences in Types VII and XVII. No splice type is discernible in Types IX (Two Rod Horizontal Foundation, Non-Interlocking Stitch), X (Rod with Lateral Bundle Foundation, Non-Interlocking Stitch), XII (Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch), XIV (Two Rod and Welt Bunched Foundation, Non-Interlocking Stitch), XVIII (Five Rod Bunched Foundation, Non-Interlocking Stitch) and XIX (Open Coiling, One Rod Foundation, Intricate Stitch). The greatest variety of splices occurs, as might be expected in Types XVII and VII; all other coiling types with identifiable splices employ a single technique. The high incidence of fag and moving ends bound under appears to be unrelated to foundation type, stitch pattern, vessel form or any other construction attribute and may well be ascribable simply to local tastes.

Mending and Decoration. Very few Antelope House coiling specimens are mended or decorated. Heavily worn adjacent coils in two specimens of Type VII coiling are reinforced with circuits of binding (wrapping) stitches and a new base is spliced with running stitches to the Type XVII ceremonial basket.

Decoration is restricted to Type XVII, where there are two occurrences of geometric designs and one of "geometricized" quadrupeds. These were produced by inserting rows of darker stitches at varying intervals. The quadrupeds also were painted.

Form and Function. The range of coiled vessel forms at Antelope House is limited to five basic configurations: shallow trays, shallow bowls, steep-sided bowls, bifurcated base carrying baskets and bifurcated base ceremonial baskets. The distribution and frequency of these forms is presented by type in Table 146. The dominant vessel

Table 145. Distribution of coiling splices by type.

	Types														
	VI	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*XIII*	*XIV*	*XV*	*XVI*	*XVII*	*XVIII*	*XIX*	*Total*
Fag ends bound under, Moving ends bound under		12	1			1					2	10			26
Fag ends clipped short, Moving ends bound under		4										1			5
Fag ends clipped short, Moving ends clipped short		1								1		4			6
Fag ends bound under, Moving ends clipped short												1			1
Fag ends bound under, Moving ends clipped and concealed under stitches												1			1
Fag ends clipped and concealed under stitches, Moving ends unknown		1													1
Fag ends unknown, Moving ends bound under												1			1
Fag ends unknown, Moving ends clipped short and concealed under stitches												1			1
Unknown	1			1	1		1	1	1				1	1	8
Total	1	18	1	1	1	1	1	1	1	1	2	19	1	1	50

Table 146. Distribution of vessel forms by type (counts = individual containers).

Forms In Profile	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*XIII*	*XIV*	*XV*	*XVI*	*XVII*	*XVIII*	*XIX*	*Total*
Shallow Tray		18	2		1	1	1		1	1		16			41
Steep-Sided Bowl								1				8			9
Shallow Bowl		5									1				6
Bifurcated Base Carrying Basket												1			1
Bifurcated Base Ceremonial Basket												2			2
Unknown	1	3		1		1					1	3	1	1	12
Total	1	26	2	1	1	2	1	1	1	1	2	30	1	1	71

form is the shallow tray, which accounts for 57.75 percent of the probable total of containers. Steep-sided bowls are a distant second in popularity, representing 12.67 percent of the containers. Shallow bowls are third, constituting 8.45 percent of the container sample. The remaining vessel forms collectively account for only 4.23 percent of the probable total of containers. The configuration of 16.9 percent of the coiled containers, including the enigmatic "handles" of Types VII (Whole Rod Foundation, Interlocking Stitch) and XII (Two Rod Stacked Foundation, Non-Interlocking Stitch), is unknown.

The popularity of tray forms is not restricted to a particular coiling type, but reflects a general preference. However, the function (or functions) of most of these trays and of the test of the coiling assemblage is difficult to determine. While a large number of the coiling fragments at Antelope House exhibit wear in varying degrees on one or both surfaces, wear patterns are relatively undiagnostic, indicating only that coiled vessels were heavily used. Most of these patterns are of the abrasion variety, suggesting that various items frequently were placed in and removed from the containers. Of the entire coiling assemblage, only four tray fragments exhibit the charring on the concave surface characteristic of parching trays. No tray or bowl fragments contain the slightest remnant of gruel or porridge. The possibility that coiled baskets were used as cooking containers, therefore, must be discounted.

More than 95 percent of the coiled containers at Antelope House are rigid. Only two semiflexible specimens, one each in Types VI and XII were recovered. Flexible coiled forms are absent.

None of the Antelope House coiled basketry is pitched or caulked, but many types contain reasonably impermeable specimens, which could have served as water vessels. As indicated in the type descriptions, these vessels are watertight by virtue of the extreme tightness of the weave and the close packing of the stitches, as well as the expansion of foundation elements when wet. Potentially impermeable specimens come from Types VII (Whole Rod Foundation, Interlocking Stitch), X (Rod With Lateral Bundle Stacked Foundation, Non-Interlocking Stitch), XIV (Three Rod Bunched Foundation, Non-Interlocking Stitch), XVI (Two Rod and Bundle Bunched Foundation, Interlocking Stitch) and XVII (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch).

Raw Materials. Only three identified genera of raw materials were employed in the manufacture of coiled basketry at Antelope House. Rods and stitches are of *Salix, Rhus* or *Yucca* and bundles always are of *Yucca*. Sixty-seven and one-tenths percent of all rods are of *Salix*, 30.76 percent of *Rhus*. The remaining 2.64 percent includes one example of *Yucca* and one of unknown composition. *Rhus* was the preferred raw material for stitches (57.14 percent), followed by *Salix* (38.96 percent). The remaining 3.9 percent are of *Yucca*.

Rod preparation of Antelope House involved immersion and decortication in 67.10 percent of the sample and immersion alone in the remaining 32.9 percent. Stitches were prepared from presoaked, longitudinally split and bilaterally thinned twigs. Bundles are composed of unspun retted fiber.

Chronology

As Table 137 indicates, coiling is continuously represented at Antelope House from the BMIII through Navajo occupations, but it is a minority subclass, representing from 35.7 percent of the total basketry assemblage in PI to 8.1 percent during Late PIII.

Foundations. The earliest foundation category present at Antelope House is a "single" rod, with a solitary example of Type XIX (Whole Rod Foundation, Intricate Stitch) ascribable to the BMIII occupation. This is the only occurrence of this type at the site. After a hiatus in PI, "single" rod foundation types and allied variants are found throughout the remainder of the sequence. "Single" rod Type VII (Whole Rod Foundation, Interlocking Stitch) appears in PII and constitutes the dominant representative of this foundation category through the Navajo occupation. Type VIII (Whole Rod Foundation, Non-Interlocking Stitch) is confined to Middle PIII, while Types IX (Two Rod Horizontal Foundation, Non-Interlocking Stitch) and X (Rod With Lateral Bundle Foundation, Non-Interlocking Stitch) are limited to Late PIII.

Two representatives of the bunched foundation category, Types XVI (Two Rod and Bundle Bunched Foundation, Interlocking Stitch) and XVII (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch), appear during

PI and the category persists through the Navajo occupation. While Type XVI is restricted to PI and PII occupations, Type XVII is represented throughout the sequence. Types XIV (Two Rod and Welt Bunched Foundation, Non-Interlocking Stitch) and XV (Three Rod Bunched Foundation, Non-Interlocking Stitch) are confined to Late PIII and Type XVIII (Five Rod Bunched Foundation, Non-Interlocking Stitch) to PIII (subperiod unknown).

Stacked foundation types are the last to appear at Antelope House. Type XII (Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch) is confined to the PII occupation and Type XI (Two Rod Stacked Foundation, Non-Interlocking Stitch) is restricted to Late PIII. Type XIII (Two Rod and Bundle Stacked Foundation, Non-Interlocking Stitch) is included in the 11.7 percent of the coiling assemblage which is of unknown age.

Stitches. Despite the preponderance of simple stitch types at Antelope House, the earliest stitch type is a single example of intricate stitches in BMIII. This stitch pattern does not recur.

The two simple stitch types, non-interlocking and interlocking, appear in PI and PII, respectively, and both persist throughout the occupation of the site. Stitches accidentally split on one or both surfaces are present from PI through the Navajo occupation. Functionally specialized stitches (e.g., double stitches or wrapping stitches ued as expansion stitches) also span the sequence from PI through Navajo.

Centers. "Plain" continuous coil centers occur in all periods from PI through Navajo. Reinforced continuous coil centers occur first in PII, recurring in the Late PIII and Navajo occupations. Flattened continuous coil centers appear in Early PIII and one example is ascribable to PIII (subperiod unknown). Only one continuous coil center is of unknown age.

Rims. Self rims are documented at Antelope House from PII through Late PIII. False braid rims are restricted to Early and Middle PIII. One combination of a self rim and 1/1 false braid rim is ascribable to PIII (subperiod unknown). A modified self rim with added wrapping stitches occurs in Early PIII.

Work Surface. Concave and convex work surfaces are present at Antelope House from PI through Late PIII. Concave work surface is represented in the Navajo occupation. Concave work surfaces predominate throughout the sequence.

Work Direction. Right-to-left is the preferred work direction at Antelope House from BMIII through Navajo. Occurrences of the opposite work direction are restricted to PII and Middle PIII, with one example of unknown age.

Splices. The earliest splice type at Antelope House is fag and moving ends bound under, which first appears in PI and continues as the preferred splicing technique through Middle PIII. Splices with fag ends clipped short and moving ends bound under occur in PII, Early PIII and Late PIII. During Late PIII, this splicing method and fag and moving ends bound under are equal in relative frequency. The remaining splice types are restricted. Fag ends clipped short and moving ends bound under represents a minority technique in Early and Late PIII. Fag ends bound under with moving ends concealed under stitches occurs only in Middle PIII. Fag ends clipped and concealed under stitches with moving ends bound under is represented only in Early PIII. The remaining splicing techniques, with fag or moving ends absent or obliterated through wear, are encountered ir PI, Navajo or unknown chronological contexts.

Mending and Decoration. The few Antelope House specimens with mends are restricted to Middle PIII. Decorated specimens are ascribable to Late PIII and PIII (subperiod unknown). One decorated specimen is of unknown age.

Form and Function. The three principal coiled vessel forms at Antelope House—shallow trays, shallow bowls and steep-sided bowls—coexist from PII to Late PIII, with shallow trays predominating. Shallow trays also are represented in the Navajo occupation and form the bulk of the container assemblage of unknown age. Bifurcated base carrying baskets are ascribable to Early PIII and PIII (subperiod unknown). The single bifurcated base ceremonial basket occurs in Middle PIII. Parching trays are restricted to PI and Late PIII.

It is perhaps significant that throughout the Antelope House sequence, the frequency of coiled vessel forms remains relatively constant. This continuity presumably reflects a lack of functional changes in the coiling industry itself. This conclusion is, in turn, supported by the lack of major changes in the frequency and type of wear patterns found in coiled vessels.

Raw Materials. All three of the major genera of raw materials employed at Antelope House for the production of coiling span virtually the entire occupation sequence. Though *Rhus* actually is the first to occur, in a BMIII context, both *Salix* and *Yucca* are present by PI. All three persist for the rest of the sequence.

The persistence of *Rhus* and *Salix* is directly attributable to their patently superior qualities as coiling construction media. No other plants available to the Antelope House weavers possessed their unique combination of toughness, flexibility and ease of working. The characteristically shiny appearance of *Rhus* provided an extra bit of aesthetic appeal to baskets so stitched. *Yucca* was the preferred source for bundles throughout the sequence because of the relative ease with which fibers could be separated from the parent mass. Again, few plants available in the Antelope House area had this highly desirable quality.

Specific identification of *Yucca* was generally not possible for the majority of the Antelope House coiling sample because of the relatively fine state of the retted fibers. The few certain examples of *Y. angustissima* are ascribable to Late PIII or are of unknown age.

Internal Distribution and Relationships

The coiling assemblage at Antelope House is differentially distributed. Fifty-nine and seven-tenths percent of the coiling assemblage was recovered from the South Area/South Room Blcok and 20.8 percent was derived from the North Room Block/North Area. The remaining 19.5 percent is ascribable to the Central Room Block. Only the numerically dominant Type XVII has pan-site distribution. The slightly less common Type VII occurs in both the South Area/South Room Block and North Room Block/North Area, but is absent from the Central Room Block.

The remaining minor coiling types are, with one exception, restricted to one or another of the principal architectural units. The entire stacked foundation component of the coiling assemblage, including Types XI (Two Rod Stacked Foundation, Non-Interlocking Stitch), XII (Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch), and XIII (Two Rod and Bundle Stacked Foundation, Non-Interlocking Stitch), is confined to the South Area/South Room Block. Two "single" rod types, VIII (Whole Rod Foundation, Non-Interlocking Stitch) and IX (Two Rod Horizontal Foundation, Non-Interlocking Stitch), are found only in the North Room Block/North Area. Six different types, including two "single" rod variants (Types VI, Bundle Foundation, Non-Interlocking Stitch, and X, Rod with Lateral Bundle Foundation, Non-Interlocking Stitch), two bundle foundation variants (Types XIV, Two Rod and Welt Bunched Foundation, Non-Interlocking Stitch, and XV, Three Rod Bunched Foundation, Non-Interlocking Stitch) and the sole open coiling variant (Type XIX, Whole Rod Foundation, Intricate Stitch) occur only in the Central Room Block. Type XVI (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch) appears in both the South Area/South Room Block and the North Room Block/North Area.

Interlocking stitch patterns are concentrated in the South Area/South Room Block, non-interlocking patterns in the Central Room Block and North Room Block/North Area. To a somewhat lesser extent, certain other basic technical attributes of the coiling industry parallel the differential distribution of foundation types and stitch patterns. Splice types in the South Area/South Room Block include many more varieties than either the Central Room Block or North Room Block/North Area. False braid rims, flattened continuous coil centers and minority coiled vassel forms are concentrated in the South Area/South Room Block and are seldom evidenced in other architectural units of the site.

The distribution of raw materials used in the manufacture of coiled basketry is more or less continuous across the site, with the three principal genera represented in all major architectural units. This even distribution of preferred construction materials is not unexpected, given the highly desirable qualities of *Rhus, Salix* and *Yucca* cited above.

The differential distribution of coiling types, stitch patterns and certain other attributes suggests either temporal or social separation of basket makers or groups of basket makers within the Antelope House population.

Certainly, there is a time factor involved in the apparent clustering of foundation types, stitch patterns, etc. within one or another architectural unit of the site. While PI (6.5 percent of the coiling assemblage), PII (11.7 percent) and Early PIII (12.9 percent) materials are very common in the South Area/South Room Block, they are absent from the Central Room Block and only

Table 147. Rotated factor matrix for Type XVII coiling (Two Rod and Bundle bunched Foundation, Non-Interlocking Stitch). N = 36. Starred (*) items represent significant loadings.

	Factors				
	I	*II*	*III*	*IV*	*Communalities*
1. Diameter of coils	.03	−.93*	.08	.10	.89
2. Coils per centimeter	−.36	.78*	.01	.28	.82
3. Width of stitches	.85*	−.25	−.13	.09	.80
4. Gap between stitches	.69*	.26	.46*	−.03	.76
5. Stitches per centimeter	−.77*	.20	.07	−.03	.64
6. Period	−.07	−.11	.94*	.03	.91
7. Area	.08	.05	.03	.98*	.97
% Variance	27.6	23.7	16.1	15.0	82.7

scantily represented in the North Room Block/ North Area. Similarly, Middle PIII coiling (10.4 percent of the coiling assemblage) is largely confined to the South Area/South Room Block. Only during Late PIII is coiling represented in all parts of the site. Significantly, the Late PIII coiling assemblage (37.7 percent of the sample) exhibits the same spatial separation of foundation types, stitch patterns and other construction attributes as does the entire coiling sample when treated as a unit at time 0.

In order to further elucidate the character of the apparent clustering within the Antelope House coiling industry, the two most common types, VII (Whole Rod Foundation, Interlocking Stitch) and XVII (Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch), were subjected to a series of statistical analyses.

Type XVII Data Structure and Distribution. Seven variables were factored to determine the structuring of habits or patterns relative to the manufacture of this coiled basketry type through time and space. Five of these attributes were measurements primarily directed toward the isolation of variant motor habits and skills within the framework of a technological type. The sixth and seventh variables were designed to monitor the behavior of these attributes temporally and spatially at the site. The variables are (1) diameter of coil, (2) coils per centimeter, (3) width of stitch, (4) gap between stitches, (5) stitches per centimeter, (6) period, and (7) architectural unit. Periods were numbered consecutively from earliest to latest, while areas of the site were numbered sequentially from south to north.

Four factors calculated by the principal axis method (a version of BMDO8M modified by J.D. Gunn to plot factor scores) were rotated to varimax criteria. The number of factors rotated was selected on the basis of eigen-values greater than 1.0. The four factors accounted for 83 percent of the variance in the data matrix, which contained 36 examples of Type XVII coiling. The rotated factor matrix is presented in Table 147.

As indicated, time and architectural unit have no great relationship to any of the selected attributes, with the possible exception of stitch gap (Factor III), which appears to become greater with the passage of time. Factors I and II show that coil characteristics and stitch characteristics have a marked tendency to behave independently of each other, as indicated by their occurrences on separate orthogonal or independant factors.

In order to examine the distribution of characteristics more thoroughly, factor scores for Factors I and II (i.e., those factors most intimately connected with the basic manufacturing process) were plotted and the point for each coiling specimen was coded for its provenience in the site (Fig. 205). Lines encircle specimens from (1) the South Area/South Room Block, (2) the Central

Table 148. Rotated factor matrix for Type VII coiling (Whole Rod Foundation, Interlocking Stitch). N = 26. Starred (*) items represent significant loadings.

	Factors			
	I	*II*	*III*	*Communalities*
1. Diameter of Coils	.20	−.58*	.62*	.76
2. Coils per centimeter	.21	.11	−.73*	.58
3. Width of stitches	−.56*	.34	.58*	.76
4. Gap between stitches	−.88*	−.05	.00	.77
5. Stitches per centimeter	.90*	.03	−.21	.84
6. Period	−.06	.11	.56*	.34
7. Area	.10	.90*	.10	.84
% Variance	28.5	18.4	23.1	70.0

Room Block, and (3) the North Room Block/North Area.

There is no separation of architectural units on the horizontal axis (Factor I) of the plot, which indicates that basket weavers from all over the site made use of coiling elements within about the same range of variation. The only notable phenomenon in this dimension is that South Room Block weavers seem to have employed elements with a greater extreme of variation than did those in the other architectural units.

The southern sector of the site is as nondescript on the vertical axis as it is on the horizontal axis. There is, however, a notable tendency for the North Room Block and the Central Room Block to locate in different parts of the factor space. To insure that the apparent clusterings were not illusory, a T-test was calculated on the Factor II scores for both groups of specimens. The difference in distribution is significant at .02 level of probability. An assessment of the Factor II loadings (Table 147) indicates that the makers of coiled baskets in the Central Room Block were using coiling elements significantly larger than those used in the North Room Block. Conversely, the occupants of the South Area/South Room Block used the full size range of coiling elements available at Antelope House.

Of the 30 specimens of Type XVII placed in time, 50 percent are ascribable to Late PIII. Sample sizes from the other periods never exceeded four, rendering it virtually impossible to delineate changes in Type XVII coiling habits through time. The only apparent conclusion that may be drawn from the factor scores is that Late PIII weavers produced a few containers with larger coiling elements than did anyone before or after them.

Type VII Data Structure and Distribution. Identical attributes for a sample of 25 specimens of Type VII coiling were treated in the manner described above. Three factors with eigenvalues greater than 1.0 resulted. These factors collectively accounted for 70 percent of the variance in the data matrix. The Type VII factor structure (Table 148) is more complex than that of Type XVII. First, the three stitch attributes do not behave independently. Second, the coil or foundation characteristics, as well as some of the variance from stitch width, appear to interact both with each other and with the spatial-chronological indicators.

Factors II and III show relationships between coiling attributes, time and space. Factor II indicates that specimens with large coil diameter tend to occur in the southern sector of the site, while small coil diameters generally are confined to the north.

Factor III indicates that coil diameter and width of stitch increased with the passage of time. The use of rods of larger diameter is apparent as one moves north in the site.

Table 149. Rotated factor matrix for intricate plaited selvages. N = 155. Starred (*) items represent significant loadings.

	Factors				
	I	*II*	*III*	*IV*	*Communalities*
1. Diameter of plaiting elements	.79*	.01	.10	.05	.64
2. Angle of crossing of plaiting elements	.16	.03	6.0	.69*	.51
3. Post 90° apex fold plaiting sequence (sub-type)	.02	.93*	−.02	−.02	.87
4. Overlap of terminal element after final interval	.63*	−.43*	−.18	.10	.62
5. Terminal element trimming angle	−.22	−.04	.76*	−.26	.70
6. Width of selvage	.75*	.50*	−.11	−.11	.83
7. Period	.17	.02	.73*	.32	.66
8. Architectural unit	−.14	−.09	−.05	.73*	.57
% Variance					67.6

While the chronological trend toward progressively larger rods may be general across the site, the continued separation of the northern and southern sections of Antelope House during Late PIII can only be attributed to non-temporal factors. Further, since raw materials are a constant through time, this clustering is probably a function of some variety of social separation relative to residential units and, presumably, kinship.

Despite the poor preservation of some of the extant coiling assemblage and its small size, it is our belief that the statistical analysis, viewed in conjunction with the differential distribution of foundation types, stitch patterns, rims, centers, etc., supports the existence of at least two and perhaps three "groups" of basket makers ("micro-traditions" of basket making) within the Antelope House population.

Plaiting

Plaiting, represented by four structural types, accounts for some 75.65 percent of the total Antelope House basketry sample. While the 466 plaiting specimens appear to represent an unusually high number of individual mats, ring baskets, bags and other forms from a single site, an exact ratio of individual "containers" to fragments cannot be calculated. Because of the great difficulty in matching individual fragments of plaiting (with or without selvage) which may be portions of the same original form, all percentages used in this section are of the total fragment sample, unless otherwise specified. The distribution and frequency of plaiting types is presented in Table 138 by raw material, period and provenience.

Technology

Of the four plaiting types present at Antelope House, three are twill plaiting variants and one is simple. Collectively, twill plaited types account for 87.34 percent of the total plaiting sample, simple plaiting types for 12.66 percent.

Types. Type XXI (Twill Plaiting, 2/2 Interval) is the most common plaiting construction, accounting for 79.83 percent of the total plaiting sample and for 91.40 percent of all twill plaited specimens. Types XXII (Twill Plaiting, 3/3 Interval) and XXIII (Twill Plaiting, 4/4 Interval) account for fewer specimens and for a smaller percentage of the total plaiting sample than does simple plaiting Type XX.

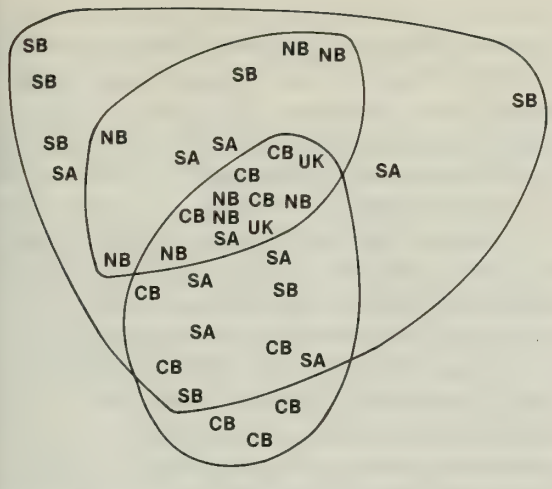


Figure 205. Plot of factor scores for Factors I (horizontal) and II (vertical) with Type XVII coiled basketry points coded for location within Antelope House.

Shifts. Intentional shifts are employed in all Antelope House plaiting types, both in the basic construction process and in the production of decorative patterns. Accidental shifts, or plaiting interval "errors," also are found in all types and may be distinguished by their irregularity and by the haphazard appearance they impart to the finished specimen.

Selvage. Three hundred fifty-four specimens, representing 75.76 percent of the total Antelope House plaiting sample, possess identifiable selvages. Of these, 166 (47 percent) are of the self type and 186 (52.54 percent) are of some subtype of intricate selvage. Two specimens, representing .56 percent of the plaiting sample with selvage, are of the continuous selvage type.

Self selvages include 131 specimens of the 90° variety, representing 37.01 percent of the plaiting with selvage sample, and 35 specimens with 180° variants, constituting 9.89 percent of the plaiting with selvage assemblage.

Subtype II intricate selvages account for 79.03 percent of the total intricate selvage sample and for 41.53 percent of all plaiting with selvages. None of the remaining subtypes represents more than 9 percent of the intricate selvage sample or 5 percent of all selvages.

Wefts on specimens of intricate selvage with twining are 2-ply unspun S-twist in 93.8 percent of the cases, and 2-ply unspun Z-twist in 5.32 percent. One example of intricate selvage with twining, representing .88 percent of the intricate selvage sample, has 2-ply Z-spun S-twist cordage wefts.

Even a cursory inspection of the Antelope House plaiting assemblage indicates that there is a marked correspondence between certain selvage techiques and "vessel" configurations. Intricate selvages occur only on plaited mats, 180° self selvages are restricted to ring baskets and to some bag forms, 90° self selvages are usually found on mats, bands, pot rests and most other minority forms, and continuous selvages occur only on tumplines. Given this correspondence, it is clear that the incidence of a particular selvage is not dictated by any local preference for that selvage, but rather by the frequency of one or another plaiting configuration. The association of a particular selvage with a particular plaiting form is, in turn, dictated by the functional requirements of that form and probably by little else. This situation contrasts sharply with coiling, where self rims predominate over false braid rims on all vessel forms, apparently by choice alone.

Mending and Decoration. The incidence of mending in the plaiting assemblage is very low (<5 percent of the total sample) and usually involves little more than the addition of a single reinforcing or binding element; in rare instances a circuit of simple twining may be added. The low frequency of mending in this subclass is partially explainable by the relatively high incidence of structural features designed explicitly to combat fraying and wear. All intricate selvages, whatever their aesthetic appeal, serve principally to reinforce the edges of mats. Integral (i.e., non-added) circuits of simple twining on mat selvages, ring baskets and some bags and other forms serve the same basic function. With the possible exception of twining, no other subclass at Antelope House has these built-in precautions against heavy wear.

If we omit the intricate selvages that may be construed as decorative, decoration in the Antelope House plaiting assemblage is largely restricted to ring basket centers and pot rests. In both cases, shifts are regularly employed to produce geometric patterns. As noted in the type descriptions, all ring basket patterns are variations of plain meanders or plain concentric diamonds; very rarely, plaiting elements of alternate

colors are used to produce linear designs, the most notable of which is a Type XXI pot rest. One plaited specimen, a Type XXI tumpline, is decorated with running stitches of human hair.

Form and Function. The principal plaiting form at Antelope House is matting, which accounts for 65.67 percent of the total plaiting assemblage. Bands constitute the next most abundant configuration, accounting for 14.11 percent of the total sample, followed, in descending order, by ring baskets (13.1 percent) and bags (3.65 percent). The remaining forms, including pot rests, rigid containers, compound and miniature baskets, tubes and tumplines, collectively account for the remaining 3.41 percent of the total plaiting sample.

As in the twining subclass, all plaited mats appear to have been rectangular, with no obvious top or bottom. Again, moderate to heavy wear on one or both surfaces attests to the extensive use of these specimens as floor coverings or as "flattened receptacles" upon which a variety of items may have been temporarily placed or stored. A few mats apparently were employed as burial shrouds or as covering. The presence of wear on only one surface of many plaited mats, coupled with a high incidence of specimens heavily worn on one side and lightly worn on the other, strongly suggests that these items were not turned over until they had been extensively abraded on one surface (cf. twined mats).

Most ring baskets exhibit wear on one or both surfaces, but the character of the interior abrasions is different from that found in coiled bowls and trays, suggesting that materials of a different composition were carried or stored in containers of each subclass.

Wear patterns on ring baskets generally are much finer, in terms of striations per centimeter and depth of striations, than those found in coiled trays or bowls. The nature of the substance or substances which generated these differential wear patterns, however, is unknown. The persistence of plaited ring baskets side-by-side with coiled trays and bowls of similar configuration suggests a need for containers with two somewhat different sets of properties. Ring baskets are light and flexible, while coiled baskets, at least at Antelope House, are heavy and rigid. The general lack of rigid plaiting or of flexible coiling attests the functionally specific nature of each variety of container and partially explains their persistence throughout the sequence.

While most other plaited forms, notably bands, are moderately to heavily worn, the wear patterns are undiagnostic and do not suggest specific function or functions.

Raw Materials. Five genera of raw materials were used in the manufacture of plaited basketry at Antelope House. Of these, *Scirpus* and *Yucca* were most often employed representing 59.87 percent and 39.05 percent of the total plaiting assemblage, respectively, with *Typha, Salix* and *Zea,* in descending order of frequency, accounting for the remaining 1.08 percent.

Specific identification is possible for all *Yucca* specimens of this subclass; *Y. angustissima* accounts for 68.13 percent of all *Yucca* specimens, *Y. baccata* for 31.31 percent, and a single specimen of leaves of both species for the remaining 0.56 percent.

There is a strong correspondence between gross plaiting configuration, or vessel form, and preferred raw material. *Scirpus* is employed almost exclusively in the production of mats and *Yucca* generally is used for ring baskets, bands and other non-matting forms. While some mats are made of *Yucca,* this genus clearly was a second choice. The infrequent use of the other raw materials suggests that they were employed only when there was no *Scirpus* or *Yucca* close at hand.

Preparation of all raw materials used for plaiting involved either simple immersion or immersion followed by longitudinal splitting.

Chronology

As Table 138 shows, plaiting is continuously represented at Antelope House from BMIII through historic occupations. It is the dominant basketry subclass throughout the sequence at Antelope House, representing no less than 50 percent of the total basketry sample during any one period.

Types. Types XX (Simple Plaiting, 1/1 Interval) and XXI (Twill Plaiting, 2/2 Interval) are the earliest and longest lived plaiting types at Antelope House. Both appear in BMIII and persist through the Navajo occupation. Type XXI also is present in the historic period. Type XXII (Twill Plaiting, 3/3 Interval) appears in PII and continues through Navajo, while Type XXIII (Twill Plaiting, 4/4 Interval) is restricted to Late PIII.

Shifts. Both accidental and intentional shifts are represented throughout the Antelope House sequence.

Selvage. The earliest selvage types at Antelope House are 90° self and intricate, which appear in BMIII and span the sequence through Navajo. Both 90° self and intricate selvages are relatively common throughout the history of the site, with intricate selvages markedly more popular only during Late PIII. Self selvages of the 180° variety are first evidenced in PII and continue through the Navajo occupation as a minority selvage type.

Intricate selvage Subtype II has the greatest longevity of any of the intricate selvage variants, persisting from the BMIII through Navajo occupations. Subtype II is the dominant intricate selvage variant in each of these periods, except PII. Subtype I occurs from PII through Late PIII. Subtypes III and IV occur in both Middle PIII and Late PIII, while subtypes V and VI are confined to Middle PIII and Late PIII, respectively.

Twining reinforcements on intricate selvages first appear in PI and continue through Late PIII. Intricate selvages without twining have a slightly greater longevity, appearing in BMIII and continuing through Navajo.

Form and Function. Matting, the dominant plaiting configuration at Antelope House, is represented from BMIII through Navajo, with a hiatus in Early PIII. Ring baskets occur from PII to the historic period. With the notable exception of plaited bands, which appear in PII and persist through Navajo, no other plaited form is found in more than two periods. Pot rests are restricted to Middle PIII and Late PIII, while rigid containers and petates occur only in Late PIII. Compound plaited baskets are confined to single occurrences in PII and Late PIII. The sole miniature plaited basket is ascribable to the PI occupation.

There is no evidence for functional changes within any of the plaited forms which persist through several periods.

Mending and Decoration. Direct evidence of mending is available from PII through Late PIII. Decorated specimens (excluding intricate selvage as decoration) occur sporadically from PII through Navajo, with the highest incidence of decoration in Late PIII. During this period, geometric designs produced with intentional shifts are relatively common on ring basket centers.

Raw Materials. Few trends are apparent in the use of raw materials for plaiting manufacture through time. *Scirpus* is relatively common throughout the sequence and is notably abundant in Late PIII. One or another species of *Yucca* also is employed from BMIII through the historic period. *Y. angustimssima* is consistently more common than *Y. baccata* in all periods, except during BMIII and the historic, when their frequencies are equal. *Salix* and *Zea mays* are restricted to Middle PIII and *Typha* occurs only in Late PIII.

Internal Distribution and Relationships

The plaiting assemblage is differentially distributed. Sixty-seven and eight-tenths percent of the plaiting assemblage was recovered from the South Area/South Room Block and 17.4 percent from the North Room Block/North Area.

Simple plaiting Type XX (1/1 Interval) and twill plaiting Type XXI (2/2 Interval) occur in all architectural units of the site. Type XXII (Twill Plaiting, 3/3 Interval) is present in the South Area/South Room Block and Central Room Block, but is absent from the North Room Block/North Area. Conversely, Type XXIII (Twill Plaiting, 4/4 Interval) occurs only in the North Room Block/North Area. The differential distribution of plaiting types is not directly paralleled in the spatial incidence of selvage types. Self selvages of the 90° and 180° varieties occur in all major architectural units of the site, as do intricate selvages. Continuous selvages are restricted to the South and Central Room Blocks.

Only intricate selvage Subtype II has pan-site distribution. Subtype I occurs only in the South Area/South Room Block and Central Room Block; Subtype III is present in all areas but the Central Room Block. Subtype IV is present in the South and North Room Blocks, while Subtypes V and VI are found only in the South Room Block.

The major plaiting forms at Antelope House, including mats, bands, bags, ring baskets and pot rests, have pan-site distributions. The minor configurations generally are restricted to one or, at most, two architectural units.

Petates occur only in the South and North Room Blocks, compound plaited baskets in the South Area, miniature plaited baskets in the North Room Block, tumplines in the South and Central Room Blocks, tubes in the South Room

Block and rigid containers in the Central Room Block.

There is no evidence that the functions of any of the matting forms varied from one part of the site to another.

The distribution of principal raw materials is once again more or less even across the site, with *Yucca* (*Y. angustissima* and *Y. baccata*) represented in all major architectural units. The minor raw materials, including *Zea mays*, *Salix* and *Typha*, are restricted to the South Area/South Room Block.

The chronological distribution of plaiting by area more or less parallels that of the other basketry subclasses. Basketmaker III plaiting is represented only in the North Room Block, while PI and PII materials occur both in the South Area/South Room Block and in the North Room Block. Early PIII plaiting is restricted to the South Area/South Block and the Central Room Block, while Middle PIII and Late PIII plaited wares have pan-site distribution. Plaiting ascribable to the Navajo and historic occupations is concentrated in the South Area/South Room Block.

Certain features of the spatial distribution of plaiting once again tend to suggest the existence of separate populations of weavers and/or of microtraditions of weaving at Antelope House. The strongest support for this premise in the plaiting assemblage is the differential distribution of basic plaiting types. The lack of Type XXII plaiting (Twill Plaiting, 3/3 Interval) in the North Room Block/North Area is not readily explainable by differential preservation or by temporal factors.

While this construction technique is a minority plaiting type, it is not uncommon in other sections of the site. Moreover, 52 percent of all Type XXII plaiting occurs during Late PIII and it is specifically during this period that the technique is absent from the North Room Block/North Area. Interestingly, Type XXIII (Twill Plaiting, 4/4 Interval) is found only in the North Room Block, again during Late PIII.

In order to statistically test the possibility that two or more groups of basket makers were operating contemporaneously at Antelope House, eight variables on a population of 185 mat fragments with intricate selvage were treated in the manner described above for Types VII and XVII coiling. This assemblage was selected for analysis because of its pan-site distribution, large sample size and structural conplexity.

Data Structure and Distribution. The eight variables examined in the intricate selvage sample are (1) diameter of plaiting elements, (2) angle of crossing of plaiting elements, (3) post-90° apex fold plaiting sequence (subtype),(4) overlap of terminal element after final interval, (5) terminal element trimming angle, (6) width of selvage, (7) chronological period and (8) architectural unit.

While Variables 1, 2, 3, 6, 7 and 8 are self explanatory, Variables 4 and 5 require further comment. In all intricate selvages, whatever the sequence of folds or intervals, the final manipulation of the terminal element requires that it be secured under another plaiting element. The distance that this secured element protrudes from beneath the element which binds it is called the overlap (Variable 4). The regularity of the overlap is, in turn, maintained by cutting or trimming the protruding element whenever necessary. The angle at which the protruding element is trimmed relative to the outside edge of the selvage is measured and represented in Variable 5. Due to the fragmentary state of some of the selvages, data on Variables 4 and 5 were unavailable; the sample, therefore, was reduced to 155.

Four factors accounted for 68 percent of the variance. The factor matrix is presented in Table 149.

Factor I appears to reflect site characteristics. As plaiting element diameter increases, so do selvage width and overlap. Factor II is related primarily to the post-90° apex fold plaiting sequence and to the width of the selvage. Not surprisingly, as the number of plaiting intervals increases, so does overall width of the selvage. Interestingly, overlap is negatively related both to the post-90° apex fold sequence and to width of selvage, suggesting that terminal elements were trimmed at more or less the same distance in any kind of intricate selvage mat. Factors I and II are not influenced by spatial or temporal characteristics, probably reflecting only the basic mechanical requirements of the plaiting process and, perhaps, the physical characteristics of raw materials.

This clearly is not the case with Factors III and IV. Factor III indicates that terminal element trimming angle and period are related. As time passed, weavers trimmed the ends of the elements at progressively higher angles to the sel-

vage margin. This tendency seems to have been universal across the site. Factor IV shows that there is a strong tendency to cross elements at a greater angle in the northern part of the site at all periods. Given the highly idiosyncratic character of preferred plaiting angle, this factor almost certainly reflects the operation of different groups of weavers in various architectural units of Antelope House. While it is not possible to present a meaningful plot of factor score loci for 155 points, the clear separation of the northern sector from the rest of the site is readily apparent.

Again, it is our belief that the statistical analysis, in conjunction with the differential distribution of plaiting types, tends to support the coexistence of at least two separate groups of basket makers (or microtraditions of basket weaving) within the Antelope House population.

Miscellaneous Fiber Constructions

Miscellaneous fiber constructions, represented by 11 arbitrary categories, account for some 6.82 percent of the total basketry sample. The 42 miscellaneous specimens represent a minimum of 41 different objects. The distribution of miscellaneous fiber constructions is presented in Table 144 by category, raw material, period and provenience.

Technology

For discussion, the 11 categories of miscellaneous fiber constructions may be lumped into three gross groups: plaited objects, nonplaited objects and construction material. Plaited objects include established forms (e.g., mats) with unknown or variable intervals, as well as such nondescript items as patches and flat plaited rectangles. This group accounts for 28.57 percent of the total miscellaneous sample and for 29.26 percent of individual miscellaneous objects. Nonplaited objects include such amorphous items as fiber-wrapped twigs and rods, figure-8 stitch hoops, figure-8 and zigzag doodles and latticework constructions. This group represents 52.38 percent of the total miscellaneous sample and 53.66 percent of all miscellaneous objects. The contents of the construction material group require no enumeration. Construction materials constitute 19.05 percent of the total miscellaneous sample and 17.08 percent of the individual miscellaneous objects.

Plaited Objects. With the exception of the variable interval perforated "handle," the representatives of this assemblage are in most recognizable particulars identical to their form counterparts in any of the plaiting subclass types. Only the fragmentary state of the miscellaneous plaited objects prevents their assignment to Types XX, XXI, XXII or XXIII. Even the perforated "handle" is readily distinguishable as plaiting and only the great irregularity of the construction intervals prevents its assignment to one or another of the plaiting types.

Non-Plaited Objects. This group represents both the most heterogeneous and the most patently artificial category used in this analysis. The constituents of this catchall taxon have nothing in common, except that they are not plaited. None resemble any other basketry specimens from Antelope House (or anywhere else). Given the amorphous character of this group of objects, any further discussion of their communal technical attributes is pointless.

Construction Material. The technical characteristics of this category are discussed below under "Raw Materials."

Form and Function. Most of the miscellaneous plaited objects are clearly representatives of common Antelope House plaiting configurations, including mats, bands, ring baskets and bags. Given this fact, we may assume that the miscellaneous objects so identified served the same function as did their counterparts in any of the numbered plaiting types. The function of the remaining miscellaneous plaited objects is either conjectural, as in the case of the alleged patches, or simply unknown.

The principal form among the non-plaited objects is the figure-8 stitch hoop, which may represent some sort of container rim, frame or cradle support. Though heavily abraded, the wear patterns afford no clues to the uses of these unusual objects. The function of the remainder of the nonplaited specimens is as enigmatic as their forms. With one possible exception, the latticework constructions may well represent bases of some variety of flexible container or an unusual form of open weave tray.

The function of the construction material is self evident.

Raw Materials. Six plant genera were employed in the production of miscellaneous fiber

constructions. Not unexpectedly, these plant sources are, with one exception, also common in the three major Antelope House basketry subclasses.

The most common raw materials for miscellaneous plaited objects include *Yucca* (usually *Y. baccata*) and, to a much lesser extent, *Scirpus*. Nonplaited objects usually were made of some combination of *Salix, Rhus* and *Yucca* (usually *Y. baccata*); two specimens in this category were constructed of *Zea mays* husks.

Plants represented in the construction materials include *Yucca* (*Y. baccata* and *Y. angustissima*), *Scirpus, Phragmites* and *Typha*. The condition of these materials provides some insight into the basketry manufacturing process at Antelope House.

The specimens of construction material range from bunches of unmodified elements to complete mat-making "kits." The bunches of unmodified elements were sorted for size to some extent, including overall length and consistency of width. This sorting may represent one of the first post-collection raw material processing operations or it may have occurred while the weaver was in the field. Another, and not necessarily sequential or related operation, is represented in several bunches of longitudinally split leaves, which were carefully cut to desired widths. These specimens may constitute the "rejects" of the initial sorting operation, which had to be modified before use, or they may represent a construction sequence in which no initial sorting for size took place. If the second alternative is correct, then bunches of a desired plant were simply collected and altered to fit standards of size. Another phase of raw material processing is reflected in a mixed bunch of *Yucca* and *Scirpus*, which apparently was immersed, perhaps preparatory to retting. The penultimate step in basketry construction, at least in one subclass, is represented in the *Phragmites* mat-making packages. Cane wraps were cut to desired lengths, sorted for mean diameter and wrapped with cordage elements, which probably were designed to function as wefts in the final stage of mat construction.

Given the abundance of basketry at Antelope House, the incidence of construction material is surprisingly low. Although this condition may be due to sampling error (in that such items went unrecognized and were ascribed to the unmodified floral remains category), it probably reflects the fact that preferred raw materials were not stored for long periods. This, in turn, suggests that the desired raw materials were locally abundant and could be collected and used whenever the need arose.

Chronology

Miscellaneous fiber constructions are continuously represented at Antelope House from PI through Navajo. This category accounts for no more than 4.5 percent of the total basketry assemblage during any one period.

Miscellaneous plaited objects occur from PI through Late PIII, with hiatuses in PII and MPIII. The greatest incidence of this group of miscellaneous constructions is during Late PIII. Nonplaited objects first appear in Early PIII and persist through the Navajo occupation. Most nonplaited objects, notably figure-8 stitch hoops, concentrate in Late PIII. Construction materials are sporadically represented from PII to Late PIII, with their highest incidence in the latter period.

Internal Distribution and Relationships

Miscellaneous fiber constructions are present in all major architectural units, although nearly 60 percent of this category is concentrated in the South Area/South Room Block. Few plaited or non-plaited objects are represented in all portions of the site, with the notable exception of figure-8 stitch hoops. Construction materials, as might be expected, also have pan-site distribution.

Given the heterogeneous character and low frequency of the miscellaneous fiber constructions, little else can be said about this category.

Conclusions

The data presented in the preceeding pages indicate the existence of a long and flourishing basketry industry at Antelope House. An unusually large fragment sample, representing an unusally large number of individual objects, has been allocated to three subclasses of basket weaves and to one miscellaneous grouping.

The many basketry specimens probably represent much, but not all, of the net total of basketry production at the site. The thoroughness and scale of the excavations, coupled with generally excellent preservation, insured the recov-

ery of what must surely be the most representative basketry sample ever derived from a single, multi-component Pueblo site. From this perspective, the sample size does not seem inordinately large; it probably reflects the actual incidence of this class of artifacts relative to other artifact classes at a more or less "typical" site of the period ca. AD 700 to 1200+.

The high proportion of individual containers to fragments is probably a function of a number of interrelated factors. Apparently, the weavers of Antelope House rarely mended worn baskets, preferring instead to discard them and to construct new ones. This, in turn, is probably due to the local abundance of raw materials, which could be tapped at will. Given these conditions, it is not surprising that little time was devoted to mending used containers. Old containers, mats, bags and the like probably were used until exhausted, at which time they were deposited, in a more or less intact state, in one of the site's refuse areas (e.g., Rooms 1, 21 and 29). Given the relatively low rate of post-disposal attrition which probably characterized these dumps, it is not surprising that so many individual containers are represented. A roughly analogous situation is well documented in prehistoric northern Coahuila (Adovasio 1974b); hence, the Antelope House case can hardly be regarded as unique.

In retrospect, the salient features of the Antelope House basketry assemblage are as follows. Twining, coiling, and plaiting are clearly of unequal importance at Antelope House. Twining, as a basketry subclass, is sparsely represented in all periods, both in absolute frequency of specimens and in types, as well as in variety and complexity of forms, selvages, etc. Viewed in this light, twining as a construction method clearly is in its death throes at Antelope House. Coiling, while characterized by a proportionately great variety of types and a very high degree of technical sophistication, still is a minority component of the basketry industry. Coiling forms are severely restricted and their incidence and character bespeak an industrial component that is slowly being phased out. Plaiting clearly was preferred for baskety production. Although it is represented by only four types, it is the most vital and heavily relied upon component of the basketry industry. The range of plaiting forms is relatively great and the degree of technical sophistication, notably in ring baskets and intricate selvage mats, eclipses any segment of the twining assemblage, as well as certain products of the coiling sample.

The popularity of plaiting probably rests, to a large extent, in the facility with which it could be manufactured, relative to the other subclasses, as well as in the usurpation of many of the functions of twined and coiled containers by ceramics. Since the principal products of the plaiting industry (matting and light flexible baskets) could not be produced ceramically, this basketry subclass retained or, perhaps, increased its popularity after the advent of pottery manufacture.

Despite the mutability of the various basketry subclasses, the industry as a whole is relatively conservative. Little change is apparent in either the form or function of basketry throughout the Antelope House sequence.

This formal and functional conservatism is eclipsed by the tenacity with which Antelope House basket weavers clung to their favored raw materials. Apparently, once a plant was found to be suitable for the manufacture of some specific basketry product the use of that plant became "permanently" established. Only if the product were discontinued would the incidence of that particular plant resource diminish or disappear. While similar situations have been documented prehistorically (Adovasio 1975a), the Antelope House example represents an extreme case.

A final comment on the socio-cultural implications of the basketry industry is warranted. As noted above, it would appear that several distinct groups of weavers were operating simultaneously at Antelope House, at least during Late PIII. Moreover, it seems that these groups may be linked to specific residential units of the site. While we have little doubt about the reality of these groupings, we do not, nor would we care to, comment on their composition. Reconstructing prehistoric social organization is a perilous task and to attempt it on the basis of even a large basketry sample is beyond our competence.

External Correlations

The 616 basketry specimens described and discussed here constitute one of the largest and best controlled basketry collections ever re-

covered from a single site (Anasazi or otherwise) in the Greater American Southwest. Though detailed comparisons of this basketry assemblage with others recovered from the same physiographic and cultural province are both warranted and potentially profitable, such comparisons are not attempted in the present work, the principal aims of which are descriptive and analytic. Comments on external correlations are limited to the following brief observations.

In most particulars, the Antelope House basketry assemblage is consistent with others from Anasazi sites. While the BMIII through PII samples from Antelope House are relatively small, there are several notable correspondences with materials from other localities. The single piece of Type XIX (Whole Rod, Intricate Stitch) coiling ascribable to the BMIII component represents a well-dated open coiling variant. This technique occurs only in BMII or III contexts and is reported for a large number of sites from the San Juan River country to the Prayer Rock district. This coiling type occasionally is encounterd in non-Anasazi contexts (see Adovasio 1970a, 1971, 1975b, 1975c), but its occurrence outside the Puebleo area is rare. The early Types XX (Simple Plaiting, 1/1 Interval) and XXI (Twill Plaiting, 2/2 Interval) plaiting from Antelope House have analogues in contemporaneous sites, although the intricate selvage type from our sample represents its first published occurrence in a BMIII context. The lack of twining in the BMIII component at Antelope House may reflect either differential preservation or the local unpopularity of this construction method.

The small PI assemblage from Antelope House includes one coiling type (XVII: Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch) previously reported in PI contexts, as well as the first published occurrence of Type XVI (Two Rod and Bundle Foundation, Interlocking Stitch) coiling from this period. Pueblo I coiled vessel forms from Antelope House correspond to known or postulated container configurations for this time horizon (see Morris and Burgh 1941: Fig. 11), although carrying baskets are absent. Plaited ring baskets first occur at Antelope House during PI, again duplicating a phenomenon noted in contemporaneous sites (McGregor 1965: pp. 245–246). The PI intricate selvage matting from Antelope House has no known parallel. However, twined matting, which is reportedly abundant in PI sites, is nowhere in evidence at Antelope House.

It is somewhat difficult to compare our PII basketry sample to those from other sites, since the sum of all other known PII basketry specimens is less than the Antelope House assemblage for this period. The PII collection from Antelope House includes one coiling type (XVII: Two Rod and Bundle Bunched Foundation, Non-Interlocking Stitch) previously reported for this period, as well as the first documented occurrence of Types VII (Whole Rod Foundation, Interlocking Stitch), XII (Whole Rod and Bundle Stacked Foundation, Non-Interlocking Stitch) and XVI (Two Rod and Bundle Bunched Foundation, Interlocking Stitch) in PII contexts. While Type VII dominates the Antelope House coiling assemblage for this period, it is not known whether this reflects a general or local trend. The occurrence of Type XII at Antelope House is somewhat unusual, as this technique is exceedingly uncommon outside the Fremont sphere in Utah; the only use of this coiling technique among the Anasazi occurred along the Fremont Frontier in the Virgin River area. Given the small size of the total known PII coiled basketry sample, it is probably unwise to label this technique as intrusive, although this may well be the case.

The PII coiled vessel configurations at Antelope House correspond to known or postulated PII forms, although the carrying basket still is absent.

The meager collections of PII plaiting and twining from other sites tend to duplicate the types and forms reported at Antelope House; however, the selvage techniques and other construction details are entirely different. Although the full significance of this disparity is presently unknown, it is suggested that local differentiation in Anasazi basketry industries was pronounced by the end of this period.

The extensive and well dated PIII basketry sample from Antelope House constitutes both the largest corpus of basketry material ascribable to this period and the most "atypical" PIII assemblage ever analyzed and described. In a great number of features, the PIII basketry from Antelope House is consistent with PIII basketry from other Anasazi sites; the high frequency of plaiting and correspondingly low incidence of twining and coiling are common characteristics; and the high frequency of two rod and bundle

bunched foundations, non-interlocking stitches, right-to-left work direction, normal centers, tray and shallow bowl vessel forms and decorative designs are "typically" PIII. The range of Antelope House plaiting types, vessel or receptacle configurations and decorative patterns are duplicated at dozens of PIII sites. There are, however, certain differences.

The high incidence of whole rod foundation coiling with an interlocking stitch is not paralleled at any published Anasazi site, nor is the very low frequency of three rod bunched coiling explainable by contemporary trends. The absence of open coiling, coupled with the high number of coiled foundations (e.g., Type XVIII: Five Rod Bunched Foundation, Non-Interlocking Stitch; Type X: Rod with Lateral Bundle Foundation, Non-Interlocking Stitch; Type XIV: Two Rod and Welt Bunched Foundation, Non-Interlocking Stitch) literally is unheard of. Moreover, the dominant splice types usually associated with PIII coiled basketry (see Morris and Burgh 1941: Fig. 9) either are not represented at Antelope House or are exceedingly rare. Conversely, the dominant Antelope House splices, with fag ends and moving ends bound under, generally are rare to absent at other PIII sites. These disparities are not restricted to the coiling industry. Similar observations may be made on the Antelope House ring basket and mat selvages, both of which seldom occur in other sites of the period. In short, while the PIII assemblage at Antelope House is certainly recognizable as a PIII assemblage, it is not "typically" PIII.

We are not, of course, suggesting that the Antelope House basket makers were individually or collectively deviant from any prevailing Anasazi "norms" or "standards" of basketry manufacture. Rather, we are questioning the alleged "norms" or "standards" themselves. A great degree of typological standardization has heretofore been attributed to Anasazi basketry (notably during PIII), largely on the basis of sample sizes smaller than the sample from a single room at Antelope House. Given the divergences noted above, this standardization would appear to be largely illusory. It now would appear that a significant amount of regional differentiation characterized Anasazi basketry production and that the roots of this regional specialization are of great antiquity. While we believe that the recognition of this variability represents the signal comparative contribution of the analyses reported here, it is assumed that future studies will elucidate the causal factors underlying it.

Chapter 21

Decorated Ceramics and Unfired Clay Objects

My analysis had two major goals: (1) description of the ceramic types and their distributions at Antelope House, and (2) formulation of the behavioral regularities reflected in the ceramics. The descriptive and behavioral analyses of unfired clay objects also are reported here. Utility wares are reported in Chapters 22, 23 and 24. The analyses of decorated and undecorated ceramics are interrelated and share many of the same goals, but they employ different methods.

The general format for each of the following subsections is to address both of the stated goals, but each section differs greatly in the sorts of questions asked and in the measure of success in answering them. Descriptive goals are geared toward the standard questions of chronology and typology to be found in the literature of Southwestern, specifically northern Arizona, archeology. The behavioral analysis makes use of some of the new concepts appearing in general theory and in the Southwestern literature (see Schiffer 1972; Reid 1973).

Typology: The Descriptive Framework

Subsumed under the first goal is the need to distinguish and understand comparable provenience units in terms of time, function and behavior. This entails the identification of contemporary rooms and floors throughout the site, using pottery classification and seriation techniques; the pottery data provide independent confirmation of the architectural analysis. The ceramics support the archeomagnetic and tree-ring dates used to determine the sequence of the structural growth of the peublo. Pottery also provides a relative dating of successive floor levels and of areas not well dated by absolute means. The use of pottery for temporal control is a necessary prerequisite for investigators working with other types of recovered materials. It also allows us to lump small proveniences into larger contemporaneous units.

The criteria and categories for classifying the pottery are based on Colton's (1955, 1956) and Abel's (1955) typologies. In using this scheme, I am not attributing any *a priori* significance to pottery wares or types, except as morphologically distinguishable ojbects having specific temporal and geographical distributions (Longacre 1970; Deetz 1965). By Hill and Evans' critique (1972), I am using Colton's ceramic typology as an empiricist model, whereby classification comes before analysis and interpretation and is viewed apart from specific research goals.

I make no presumptions about what our types mean, other than to regard them as time-space indicators. In the classic archeological debate over the "significance" of types, I must agree with Brew (1946) that a ceramic typology should be an arbitrary, objective classification system. The defining attributes of the types should be chosen in consideration of the specific research goals of the analysis. This view is promoted by Hill and Evans (1974) as the "positiv-

Table 150. Raw decorated pottery counts at Southwestern pueblo sites.

Site	*Total No.*	*No. of Critical*	*%*	*No. of Rooms*	*% Excavated*
Antelope House	8,388	2292	27	91	85
Broken K	12,807	6348	49	95	46
Carter Ranch	18,426	6000	32	39	59
Mug House	16,136	—	—	94	100
Big Juniper House	6,890	—	—	27	100

(Figures from Hill 1970, Longacre 1970, Rohn 1971 and Swannack 1969.)

ist" model for classification and is discussed by Thornton in terms of its application to the analysis of utility ware from Antelope House (Chapter 24).

We cannot assume that types represent cognitive templates in the minds of the makers or that different uses of attributes represent different cultural traditions (Gifford 1960; Ford 1954; Rouse 1960). For example, it is common to proceed on the assumption that an abrupt increase in frequency of Mesa Verde types at a site dominated by Kayenta Tusayan types represents a southwesterly migration of Mesa Verde peoples (Anderson 1971). Without supporting evidence for population movements, trade or other cultural processes, we cannot make this sort of *a priori* generalization and must view Mesa Verde Black-on-white wares only as types possessing attributes most commonly found in the Mesa Verde area from the mid-13th to 14th centuries (see Martin and Plog 1973: 343 for a similar argument). This is not to say that questions of the cultural or cognitive significance of pottery manufacture are not worth investigating for certain research designs. Rather, by making explicit our criteria for categorizing pottery, we avoid circular arguments, in which we test hypotheses of cultural dynamics using the same classificatory criteria. This difficulty is illustrated by the statement: "Pottery types have cultural significance. Therefore, cultural change is reflected by changes in pottery types."

I use the standard pottery types to formulate hypotheses of population structure and origin at Antelope House, but the testing is done with attributes independent of those used to classify the pottery, such as relationships with other artifacts, evidence of use and distribution. This is one of the reasons pottery should not be typed according to how old one thinks it is or according to the region where it is found; it should be typed purely on the empirical attributes inherent in the artifact. Colton's typology is employed, therefore, insofar as it satisfies the chronological needs of my research. It is quite adequate for that purpose (Hill and Evans 1972: 263).

Sampling Problems

The Archeological Context of Ceramics

In this section, I describe the archeological context of the ceramic sample. This is a necessary step for understanding the acquisition and use of the pottery before it became part of the archeological site and for grouping temporally and functionally comparable proveniences (Reid, Schiffer and Neff 1975).

One of the major limitations on ceramic analysis at Antelope House is quantity, as there are few decorated sherds or whole vessels in critical (i.e., floor contact) proveniences. In 21 of the 70 excavated or sampled rooms, there are fewer than 10 decorated sherds associated with each living surface. This is much too small a sample for dating or for any meaningful type of attribute analysis. Within stratified room deposits, floors devoid of decorated pottery or bearing only a few unidentifiable sherds often were found.

Two thousand, two hundred and ninety-two decorated sherds were recovered from critical proveniences in rooms, representing 26.9 percent of the 8388 decorated sherds recovered from all excavated floor contact and room fill proveniences. Although the number of critical sherds is low, the total ceramic population is also low, as can be seen by comparing these sherd counts with those from other sites (Table 150).

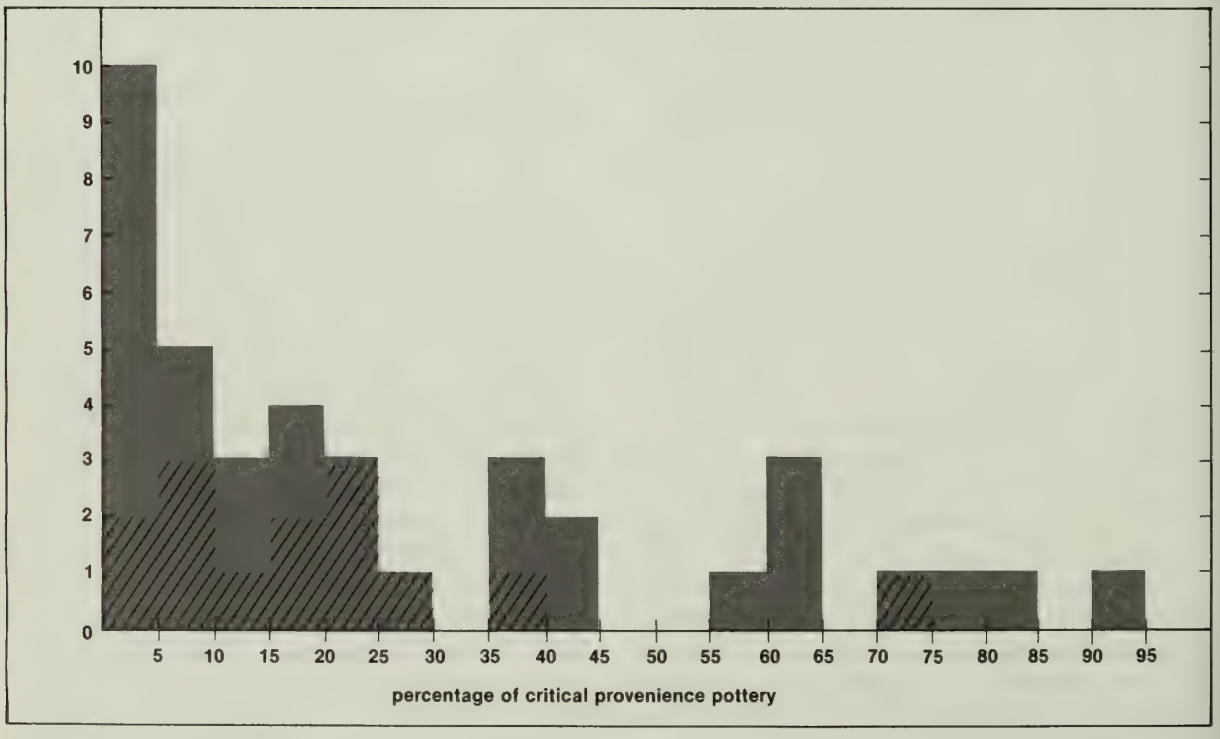
The important question is whether the 2292 decorated sherds are representative of the total population of excavated pottery and whether it is large enough for dating. I think the answer for the site in general is yes in both cases. Figure 206 shows the distribution of frequencies of critical provenience sherds as percentages of total pottery counts for rooms. These percentages are obtained by dividing the number of sherds found on the floor of a room by the total number of sherds, including fill, found in that room. Basketmaker III rooms without decorated pottery and rooms that were simply tested have been omitted. While amost half the room floors contain only 10 percent or less of the total recovered pottery from that room, the mean percentage for the whole site is 27.2 percent, with a range from .6 percent to 53.8 percent. Much of the variability here is due to those extreme cases with very few sherds per room. If only rooms with large samples of pottery are examined, the extreme values of very high or low frequencies of critical provenience ceramics are eliminated. For rooms with over 100 sherds (hatched area on Fig. 206), the mean percent of critical provenience pottery in rooms is 20.8, ranging from 2.5 to 39.1.

Judging sample adequacy will always be subjective, but if we apply, for argument's sake, a sample size of more than 5 percent critical provenience sherds for populations of more than 100 and a sample size of more than 10 percent for populations of less than 100, then all but 12 rooms are acceptable. In other words, 27 of the 39 intensively excavated rooms have enough pottery in critical proveniences to possibly represent all the ceramics in that room. For dating purposes, either the pottery from fill proveniences or absolute dating evidence must be used for those rooms with less than 100 sherds or 10 percent critical provenience pottery on the floors. This situation is more acute in the North Room Block, which was occupied later and for a shorter time than were the excavated proveniences of the South Room Block.

Cross-mending of Ceramics (within rooms)

That most of the decorated ceramics are secondary refuse is verified by recording cross-mends between floors and rooms in selected proveniences. "Cross-mends" are broken sherds that come from the same vessel but different proveniences. This procedure also revealed some

Figure 206. Percentages of critical provenience (floor contact) decorated pottery in rooms sampled.



facts about the archeological contexts of site stratigraphy.

All decorated sherds from Rooms 1, 5, 29, 30, 47 and 21 were examined. These rooms were chosen because they have deep strata or multiple floors. Each cross-mend was recorded, noting whether proveniences were contiguous, naturally or arbitrarily divided, and critical. I hypothesize that if "natural strata" (distinguished by soil color, composition and artifact content) represent refuse from temporally and behaviorally discrete depositional events, then there should be significantly fewer cross-mends between natural layers than between arbitrarily divided layers.

The results show a significant correlation, but it is the reverse of that predicted. We see that there is actually a greater frequency of natural layers with cross-mends than of arbitrarily divided layers with cross-mends. Furthermore, almost all of the critical proveniences that were examined contained some cross-mends and these proveniences are the focus of most of the ceramic analysis. In many instances, these mends are not between contiguous layers, but between layers separated by floors and more than one "natural" stratum. Thus, even critical proveniences that are natural layers may be mixed.

I must conclude that naturally divided layers do not necessarily contain ceramic remains from discrete depositional events. This will affect our behavioral interpretation of material remains and our definition of comparable archeological units (Reid, Schiffer and Neff 1975).

For chronological purposes, the pottery seriation should not be adversely affected by cross-mends. The great number of cross-mends does not skew the seriation at Awatovi, despite the fact that all ceramics are in secondary refuse contexts (Burgh 1959; Smith 1971).

My null hypothesis states that there is no relationship between the type of stratigraphic unit and the presence of cross-mends. A table of observed (O) and expected (E) frequencies (Table 151) was used to compute the chi-square test of the hypothesis. The null hypothesis is rejected at the .05 significance level. Therefore, it is concluded that there is a relationship between cross-mends and strata type that is greater than would be expected by chance alone.

I expect these seriations to be unbiased, even though 45 percent of the cross-mended levels at

Table 151. Chi-square figures—cross-mends.

		Type of Strata		
		Natural	*Arbitrary*	
Cross-mend	+ O	16.0	17.0	33
	E	12.6	20.4	
	− O	2.0	12.0	14
	E	5.4	8.6	
		18	29	47 = n

Computed $x^2 = 4.97$
Probability under H_0 that x^2 (ldf) 3.84 : .05

Antelope House are noncontiguous, in contrast with the 6 percent noncontiguous cross-mends at Awatovi. This is verified by a cross-tabulation of ceramic types with the dates of proveniences in which they occur (Appendix I). The dates are lumped into Basketmaker III, Pueblo I, Pueblo II, Early, Middle and Late Pueblo III and General Pueblo III periods, based on dendrochronology, archeomagnetism and architecture, which are methods independent of ceramic dating. The completed temporal sequence for the site combines all of these elements. Very few anomalies are found between pottery dates (Breternitz 1966) and their occurrence in dated critical proveniences. In general, the early rooms do not contain later pueblo pottery, indicating that there is little mixing from later proveniences. Pueblo III floors, however, generally contain small quantities of Pueblo I and II pottery. This causes a skewing, or stretching out, of the classic battleship curve seriations. This pattern is characteristic of secondary trash refuse in continuously occupied sedentary sites (Ford 1949).

The causes of the "upward skewing" of the ceramic seriation can be attributed to a number of cultural and noncultural formation processes observed at Antelope House: (1) the recycling of earlier pottery, especially as wall chinking, which mixes with other pottery when the walls collapse (the selection of earlier sherds for scrapers, discs, and other tools also contributes to this process); (2) intentional fill of open spaces with earlier trash (this is most evident in Rooms 1 and 47); and (3) general disturbances of lower strata by the digging of pits and burials, by rodent activities and by other activities taking place at a continually occupied site.

The specific anomalies identified in the cross-tabulations are: (1) Floor 5 of Room 1 yielded the

largest absolute and relative number of Pueblo I pottery of any provenience at the site (Appendix I). Of the 369 sherds in critical proveniences, 61.5 percent are Kana'a Black-on-white, 29.3 percent are Red Mesa Black-on-white and 8.0 percent are Kiatuthlana Black-on-white. However, the tree-ring dates and architectural analysis show that this room was built in the Pueblo II period and not during Pueblo I, as the pottery might suggest. In addition, most of the sherds are mendable into about 13 discrete, partially restorable vessels, suggesting primary refuse as defined below. This dating anomaly indicates intentional Pueblo II fill from a primary Pueblo I refuse deposit. If the origin of the fill were secondary refuse, I would expect a greater number of vessels to be represented and fewer sherds per vessel, as was the case in the fill of Room 47; (2) Floor 5 of Room 29 yielded one sherd of Pueblo III Tusayan Black-on-white although it dates to the Pueblo II period. This, however, makes up only 1.3 percent of the pottery in this provenience. Similar instances of one or two sherds of late Pueblo III Mesa Verde Black-on-white on earlier floors are found in Room 21, Floor 4; Room 75, Floor 1; Room 77, and Kiva D. These anomalies can be attributed to rodent activity, wall slumping or pot-hunting.

Horizontal Cross-mends (between rooms)

Cross-mends between rooms indicate horizontal scattering of sherds from discrete pots, due to the method of discard (literally throwing a pot away). The processes previously mentioned for the vertical displacement of pottery can also produce horizontal displacements.

The discoveries of horizontal mends resulted not from a systematic mending project on my part, but from occasional and accidental recognition during ceramic analysis. These discoveries do not represent the total number of horizontal mends within all proveniences, nor can they be considered an adequate sampling of this phenomenon.

Cross-mends between contiguous rooms are more common than are those between separated rooms. All horizontal cross-mends are between proveniences dated to Middle and Late Pueblo III. This suggests that erosion, a major contributor to disturbances in the uppermost levels, did not occur until after final abandonment of the site.

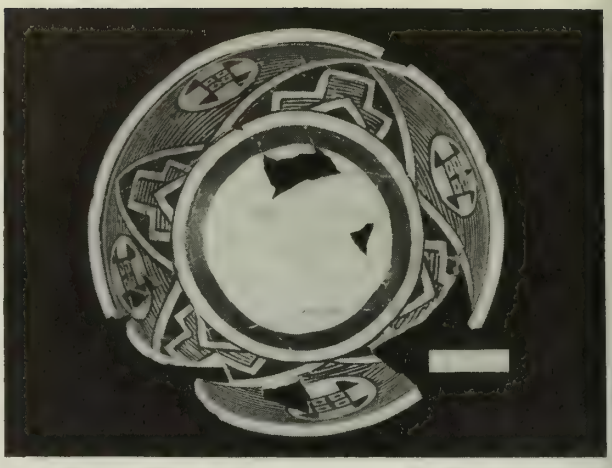


Figure 207. Top view of a distinctive Mesa Verde Black-on-white bowl found scattered in the trash fill of the South Plaza and Room 29.

The seven vessels involved in horizontal cross-mends date to Pueblo III. Five vessels are Mesa Verde Wares, one is Tusayan Black-on-white and one is Chaco Black-on-white. Those mends occurring between proveniences in the same room block or close together include:

1. Room 1, Proveniences 330 and 331, mended with Room 21, Proveniences 308, 309, 312, 319, 329 and 336, and with nearby Grid G1 41, Provenience 314, and Grid G1 43–44, Provenience 303.

2. Room 6, Provenience 590, mended with Room 45, Provenience 610. Both are room floors in the north half of the site, but they are some distance apart.

3. Room 29, Provenience 1176, mended with nearby Grids G 234, Provenience 122, and G233, Provenience 120 (Fig. 207).

4. Room 42, Provenience 236, mended with Room 43, Provenience 602, Room 54, Provenience 646, and Grid L2 63, Provenience 260.

5. Room 42, Provenience 255, 247 and 242, mended with Room 50, Provenience 628.

Those mends between spatially distinct areas of the site include:

1. Room 21, Proveniences 329, 338 and 361, mended with Rooms 42 and 234 and with Grid 345, Provenience 577.

2. Room 46, Provenience 601, mended with the Tower Corridor, Provenience 279.

Behavioral interpretation of ceramics based on associations with architectural features or other artifact categories is all the more difficult because the material studied represents second-

ary refuse. We cannot, in most cases, relate artifact assemblages to behaviorally discrete events or to the specific loci of those events. For example, ceramics used for the preparation and consumption of food in a specific domestic group will not be found on a floor, but will be displaced in time and space by their deposition as secondary refuse.

As a result of the cultural and natural transformations of the archeological remains described above, the specific function and identification of activity spaces is even more difficult. Therefore, many of the hypotheses concern gross differences between the larger units at Antelope House: the North, Central and South Room Blocks. The structure of the ceramic data permits more reliable statements on social organization, behavioral variability and gross temporal changes on the intra-village level than on the specific activities in particular rooms. Thus, critical proveniences represent refuse from behavior that is temporally related, but not necessarily behaviorally related, to floors.

Primary, Secondary and De Facto Refuse

These terms have been generally defined by Schiffer (1972) and Rock (1976). The distinctions that they represent will become more and more important for archeological interpretation.

The pottery is divided into these analytic units on the basis of objective (though untested) criteria:

1. *De facto* refuse—(a) whole pots, (b) restorable vessels and (c) a few sherds representing a number of whole restorable pots. At Antelope, House these were found primarily in caches or in burned structures, which demonstrates that the use life of these vessels was not exhausted.

2. Primary refuse—(a) many sherds representing a limited number of pots (contrasted with the smaller number of sherds representing whole pots in the *de facto* refuse category), and (b) partially restorable vessels when more prevalent than secondary trash. Most whole ceramic vessels in this category come from burials. No other evidence was found to indicate that the use life of the ceramics ended at the location at which they became part of the archeological context.

3. Secondary refuse—(a) many sherds representing many different pots, usually with only a few sherds present for each distinct pot, and (b) many other types of debris mixed with the ceramics. These ceramics were found in proveniences identified as trash or room fill.

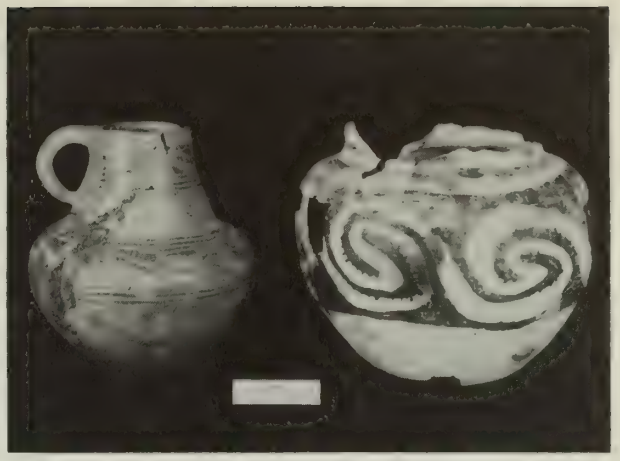


Figure 208. Medicine Black-on-red (left) and Black Mesa Black-on-white jars from a subfloor cist (Feature 2) in Room 18.

De Facto Refuse

De facto refuse is rarely encountered. I did not find the pattern of *de facto* refuse on the latest occupation floors and only secondary refuse on earlier floors, as was observed at the Grasshopper Site (Longacre and Reid 1974; Rock 1974).

Instances of *de facto* refuse at Antelope House are rare enough to be listed here:

1. Feature 2 in Room 18 is a sealed-over, stone-lined subfloor cist, containing two corrugated and two decorated vessels. All of the vessels have sandstone lids. The room has the typical features of a kiva: an air vent, wind deflector and loom holes. Although the room is dated to Late Pueblo III, the Medicine Black-on-red jar and the Black Mesa Black-on-white jar found in the cist (Fig. 208) date to Late Pueblo II—Early Pueblo III. The Black-on-red jar is repaired with pitch and drilled holes are present, attesting that its use life was extended for a considerable time. I can only speculate that this "heirloom" had some function within the kiva that made its maintenance important. Cultural factors, then, can be added to the list of processes contributing to the dating anomalies mentioned above.

2. The fill above Floor 5 in Room 29, Provenience 1318, is one of the four instances of *de facto* refuse near a floor, but not on it. Forty-eight unfinished, but usable, stone, vegetal and clay artifacts were found in a layer just above the floor in a context suggesting a storage area. Ve-



Figure 209. Anthropomorphic figurines (a-1) and cradle models (m, n) from Antelope House (see text for description and discussion).



Figure 210. Sosi Black-on-white jar from the fill in Room 1.



Figure 211. Kana's Black-on-white jar from the fill of the Tower Corridor.



Figure 212. Decorated vessels from Burial 5 (clockwise from top left): Wingate Polychrome bowl, unidentified Tusayan Ware pitcher repaired on the outside with pitch and Dogoszhi Black-on-white pitcher.



Figure 213. Decorated vessels from Burial 11.



Figure 214. A Reserve Black-on-white ladle found with disturbed human remains in a pit in Room 44.

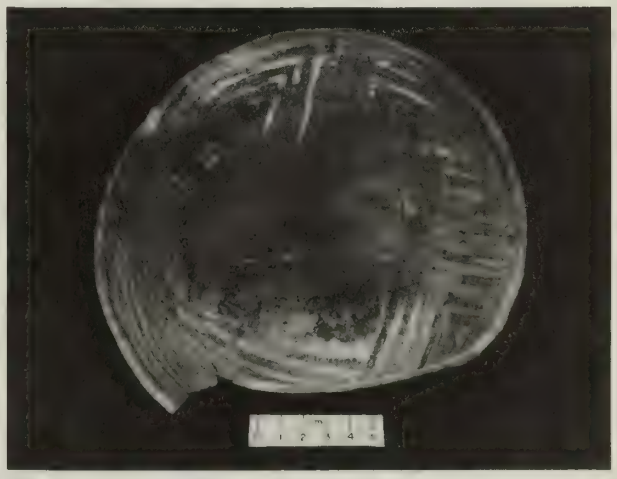


Figure 215. A McElmo Black-on-white bowl from Burial 8, Room 48.

getal artifacts included many handles (some partially finished), wooden projectile points, corn ears and vegetal rings. The clay items are mostly crude unfired miniature vessels, which are associated with pottery-making tools and which may signify a pottery production area. This is discussed in the section on unfired clay objects.

3. The fill above Floor 3 in Room 21, Proveniences 335, 346 and 366, is very similar to that in Room 29, in that it contains unfinished handles, vegetal loops and projectile points in a possible storage context; no ceramics were found in this fill.

4. Rooms 59, 67/71 and 69 are Basketmaker III structures and were burned and abandoned during that period. Whole undecorated vessels and typical Basketmaker III figurines (Fig. 209: b, c) were found on the small sections of floors that were excavated.

5. Whole cached pots were found in trash layers in the southern half of the site, as follows: (1) Room 1 (1238), FS 1965—Sosi Black-on-white jar (Fig. 210); (2) Room 29 (1266)—Tusayan Polychrome bowl (partial pot); (3) Tower Corridor (1502), FS 2139—Kana'a Black-on-white jar (Fig. 211). All other cached vessels are utility wares and are reported in Chapter 21.

Primary Refuse

The few burials excavated at Antelope House provide all of the primary refuse decorated vessels recovered. Burial 5 (319) yielded four vessels (Fig. 212), Burial 11 (1258) yielded nine vessels (Fig. 213), an unnumbered burial from Room 44 (606) yielded one ladle (Fig. 214), and Burial 8, Room 48 (619) yielded one bowl (Fig. 215). Table 152 lists these vessels by provenience, giving ware, type, color and shape of each.

Decorated Ceramic Types at Antelope House

There are 36 identified decorated ceramic types, grouped into eight wares, at Antelope House. The distribution of types among floors and rooms is given in Appendix I.

Such a large number of types has not been reported for other sites in Canyon de Chelly, but Antelope House is one of the first sites in the area to be systematically excavated. The site also has an occupation span of more than 500 years

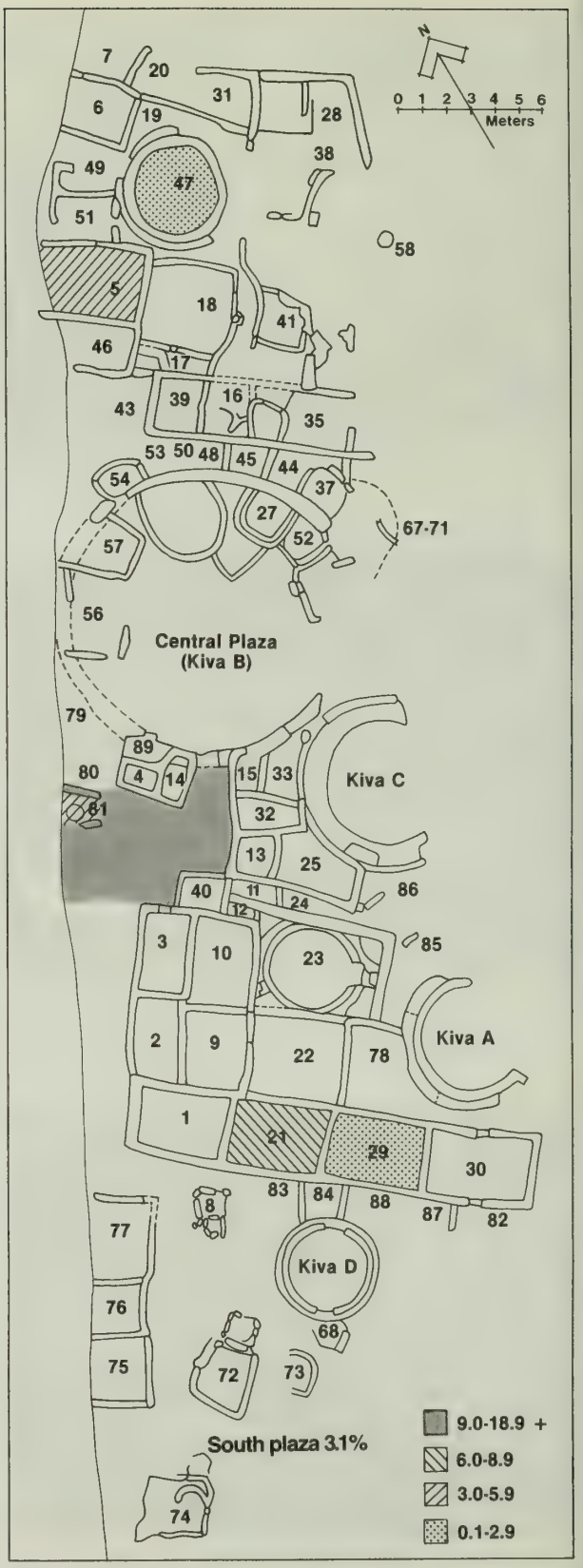


Figure 216. Distribution by percentage of Kayenta Wares, Pueblo III.

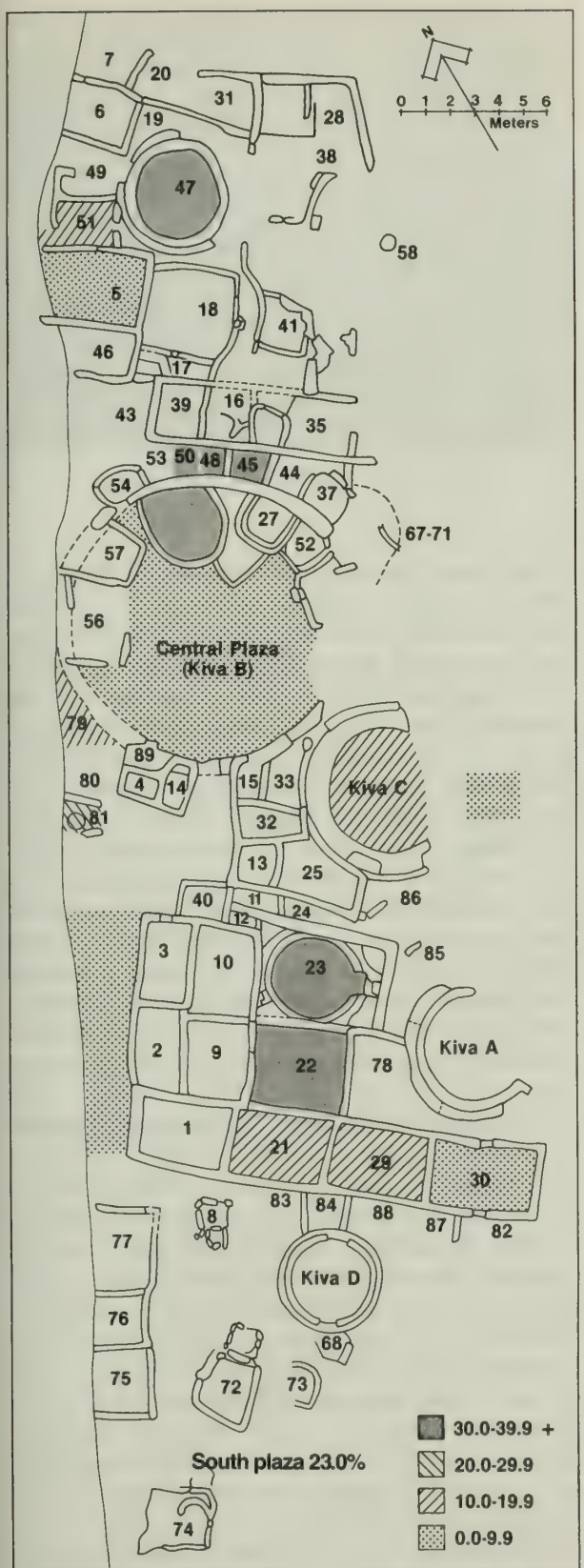


Figure 217. Distribution by percentage of Mesa Verde Wares, Pueblo III.

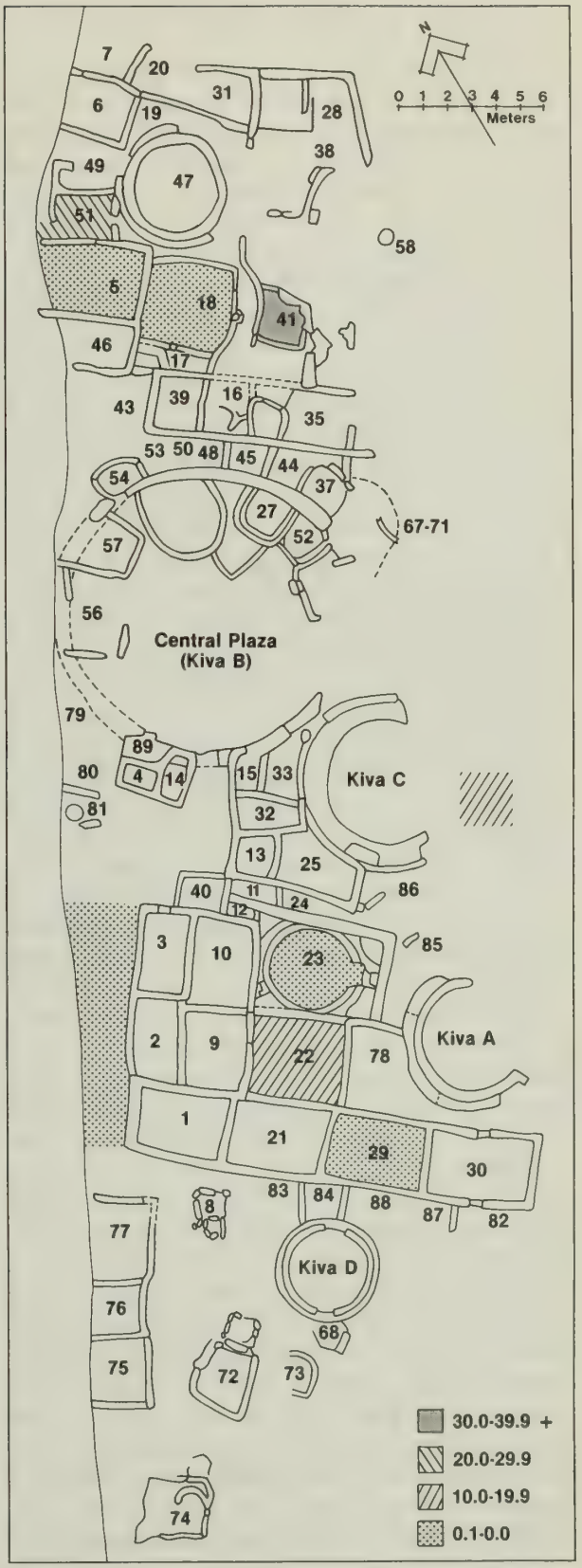


Figure 218. Distribution by percentage of White Mountain Redwares, Pueblo III.

and decorated ceramics were made for more than four-fifths of that time.

The predominant Pueblo I Tusayan type is Kana'a Black-on-white; Red Mesa Black-on-white is predominant among Cibola wares. Most were found in the peculiar fill above Floor 5 in Room 1. Because Pueblo I proveniences were not systematically excavated, most early sherds reported here were found in later trash deposits. Appendix I gives the distribution of types among proveniences dated by dendrochronology and archaeomagnetism. Other early types, found in low frequencies, are White Mound and Kiatuthlana Black-on-white. Cibola Ware continues to be found throughout the occupation of Antelope House, although it never approaches the quantities of Red Mesa Black-on-white found in the earlier horizon.

The Tusayan Wares and other wares of the Kayenta series continued to predominate in the Pueblo II-Early Pueblo III period. These types are characteristic of the Kayenta District west of Canyon de Chelly (Beals *et al.* 1945). However, the best sampled period in terms of all artifact categories is Pueblo III, during which there was a significant change in the relative frequency (i.e., percentage) of wares (Fig. 216, 217, 218). The Kayenta wares decreased drastically, with three Kayenta Black-on-white and 34 Tusayan Black-on-white sherds accounting for only 2.1 percent of the Late Pueblo III assemblage. The quantity of Mesa Verde Ware (Fig. 219, 220), on the other hand, increased radically in Late Pueblo III. There are 38 McElmo Black-on-white, 113 Mesa Verde Black-on-white and 155 unidentified Mesa Verde Ware sherds; the 306 Mesa Verde Ware sherds accounted for 18.5 percent of the Late Pueblo III assemblage. This actually is the predominant ware of Late Pueblo III, but it seems lower in proportion to the entire assemblage because of the large quantities of earlier wares found in trash deposits. It can be seen in Figure 217 that many individual rooms contained much higher ratios than did the site as a whole; rooms labeled Late PIII on the map had no Mesa Verde sherds. All those rooms that are unhatched and unlabeled predate Pueblo III and should not be expected to contain Mesa Verde Black-on-white. The distribution is more indicative of dumping patterns in Late PIII than of anything else. Evidently, Kiva C and the kivas in Rooms 47 and 23 were filled with trash during Late PIII, when



Figure 219. Side view of Mesa Verde Black-on-white bowl pictured in Fig. 207.

Mesa Verde Ware was predominant. The relatively unstratified deposit in Room 47, particularly, is indicative of intentional fill. In the Central Room Block, Room 42 (which is a ceremonial room) and adjoining Rooms 45, 48 and 50 also have large percentages of Mesa Verde Ware, although the absolute numbers are small. High frequencies also are found in the South Plaza and in Rooms 21, 22 and 29, which are adjacent to the filled kiva in the South Room Block.

The general pattern of refuse discard indicates a tri-modal system. Abandoned rooms in each of the three room blocks were used as trash dumps, while contemporaneous and adjoining rooms were kept relatively free of trash and possibly were used for habitation. The South Plaza also was a major discard area in Late PIII times.

Comparisons and Interpretations

Tse-ta'a Pueblo is the only excavated site reported in Canyon de Chelly (Steen 1966) and the ceramic assemblage there differs from that at Antelope House. The differences, however, are due not to behavioral factors, but to the different classification system used at Tse-ta'a.

The site is located in Canyon de Chelly proper, approximately halfway between White House and Sliding Rock. Although Antelope House is in Canyon del Muerto, the two sites are not so distant that major ceramic differences would be expected.

Pueblo I ceramics reveal some similarities. Kana'a Black-on-white predominates at both sites.



Figure 220. A typical Mesa Verde Black-on-white mug from the floor of Kiva 47.

Red Mesa Black-on-white was not recorded at Tse-ta'a, but it occurs at Antelope House with sufficient frequency to question the usual assumption that it is a tradeware. Examination of the typed sherd collection from Tse-ta'a at the Western Archeological Center shows that Kana'a and Red Mesa were lumped together.

Pueblo II ceramics differ greatly at the two sites. Steen found "Mancos Black-on-white" predominant, with Chaco, Sosi, Gallup and Holbrook Black-on-white types occurring in much lower frequencies. The predictable Wingate and Tusayan Black-on-red sherds also were found in low frequencies, with Tusayan Black-on-red predominating in this category (Steen 1966: 88). At Antelope House, there is no indication that Mancos is the "local" type, as concluded by Steen, since it makes up only .6 percent of the assemblage (14 sherds). The predominant types again are the Tusayan Whitewares, with Black Mesa and Sosi Black-on-white occurring most frequently. Black Mesa Black-on-white is by far the most common PII pottery at Antelope House, but it is not reported from Tse-ta'a. Small amounts of Chaco, Puerco and Gallup Black-on-white from the Cibola series occur at Antelope House, as do the Late PII to Early PIII redwares, Medicine Black-on-red and Tusayan Black-on-red.

The reasons for the discrepancies between the two sites may well be due to the typological criteria used by the researchers and not to any actual differences in the ceramic assemblages. Steen (1966: 88) admits that he has lumped several black-on-white types into the "Mancos" heading, following the example of Able (1955). I suspect that the PII Tusayan Wares so well represented at Antelope House have been lumped with other unspecified types at Tse-ta'a. I also suspect that some Red Mesa Black-on-white of the Pueblo I period was also incorrectly assigned to this category, since the paints and designs are similar to those used in Cortez Black-on-white, which Steen lumped in the Mancos category. Steen apparently disregarded the differences in temper between Red Mesa Black-on-white and Cortez Black-on-white, as well as the differences between mineral and carbon paint in Mancos and Tusayan types. Steen's typology is generally questionable, therefore, because of the great amount of lumping and the lack of explicit criteria justifying such a practice. This problem is emphasized by Steen's exceptional ability to put all but a few sherds in a type category (1966: 81).

Pueblo III ceramics at Tse-ta'a more closely conform to the Antelope House assemblage. At both sites there is a predominance of Mesa Verde and McElmos Black-on-white. These types may indicate a possible migration into Canyon de Chelly by people making a kind of pottery characteristically found in areas north and west of Canyon de Chelly (Steen 1966: 91; de Harport 1959: 1579ff). The apparent absence of PIII Tusayan Ware at Tse-ta'a most probably is a result of lumping late Pueblo pottery into the all-inclusive Mancos category (Steen 1966: 92). Steen's assumption that Kayenta Wares were traded into the canyon is not supported by the Antelope House evidence for PII times, when Kayenta Wares predominate. Furthermore, Mesa Verde Ware might just as well have been locally produced, rather than traded in PIII times as assumed by de Harport (1959: 1580).

Polychrome vessels from PIII times at Antelope House are predominantly Wingate Polychrome and St. John's Polychrome. Tusayan Polychrome and one or two other polychromes also occur. This range of types is much the same as that from Tse-ta'a, except that Tusayan Polychrome predominates there; at Antelope House, St. John's Polychrome is by far the most common type.

Recycling and Repair of Ceramics

The occurrences of repair holes, reworking and wear on pot sherds is commonly recorded

in site reports (Rohn 1971: 189, 99 ff; Swannack 1969; Martin *et al.* 1964: 104; Judd 1954: 184). Formal functional interpretations usually are provided for this material, but broader explanations of the behavior involved in recycling are not. Correlations of frequency of repair with standard pottery types show that behavioral patterning relates to relative "value" of certain types and that there is an increase in repair through time. At Antelope House, explanations of these behavioral patterns involve the energetics of procuring pottery and the standardized uses of certain types of ceramics. A useful analytic tool is derived by using data on repair to model the flow of ceramics through a behavioral system leading to their deposition in the archeological record.

Because only the occurrences of altered sherds and of ceramic types are needed for this analysis, hypotheses can be tested without relying on the proveniences of the sherds. Since almost all pottery at Antelope House comes from temporally mixed secondary refuse, this kind of analysis is especially appropriate.

Recycled Sherds

Some basic terms must be defined at the outset. Recycling refers to the use of a sherd in a new set of activities, which may or may not involve the modification of the sherd prior to its reuse. Examples include sherds crushed to make temper for pottery production, a sherd used as a scraper and a sherd with edges ground to form a disc. Only those sherds that are clearly recycled (having grinding or chipping marks) will be discussed. Sherds used as chinking in architectural construction or as pottery temper are not easily identifiable, unless fallen wall fragments are found intact or in other special situations. Shepard (1936) cites reports of instances in which certain potters randomly selected sherds for temper, while potters at other pueblos systematically rejected utility ware sherds as unsuitable. Presumably, any sherd from a secondary refuse deposit would suffice for wall chinking at Antelope House, but no systematic study of sherd types in walls was undertaken. The effect of ceramic mixing due to fallen walls has already been noted as contributing to the occurrence of earlier pottery in late proveniences at Antelope House (see also Stanislawski 1969).

Recycled sherds used in this analysis can be placed in three formal categories, based on the type of modification (see Swannack 1969: 99 ff for a more elaborate typological system):

1. Geometric sherds have edges ground perpendicular to the surfaces of the sherds. They are traditionally classified as "gaming pieces" or "pendants" (Fig. 221: b, d, e). Some discs may have been used for burnishing pottery or for other manufacturing operations, but this is difficult to determine. No perforated sherd discs were found, although perforated discs of horn, squash and wood do occur.

2. Unmodified edge-worn sherds are those reused directly, without alteration. Edges usually are beveled from wear, indicating use as scrapers or abraders. It is impossible to determine, as is the case with the Flagstaff Black-on-white bowl sherd illustrated in Figure 221: c, whether the beveled edges of some sherd scrapers are the result of prior shaping or of scraping activities.

3. A recycled sherd of indeterminate function is a Mesa Verde Ware mug or jar handle ground smooth on its broken edges. It apparently was salvaged to preserve the anthropomorphic figure painted on it (Fig. 221: a).

Repaired Vessels

While occurrences of repair holes in sherds are few (29 of 2250 examined sherds), there are enough to provide some significant results. It should be noted that repaired vessels once irreparably broken will produce only a few sherds with evidence of repair.

There is a specific set of technological operations for extending the use life of damaged vessels at Antelope House. The most common practice is the drilling of repair holes from the exterior of the vessel on either side of the crack or break. A few evidence drilling from the interior in order to prevent surface spalling when the drill penetrated the pot. (Precautions were taken in the lab to distinguish holes drilled for suspension; these would be close to the rim of the vessel and would not be associated with an ancient break.) Vegetal material then was wound through the holes to bind the break (Fig. 222, 223). Strips of *Rhus trilobata* (skunkbush) were used in nine of the 12 repaired specimens with vegetal material preserved. Exploiting the good qualities of *Rhus* for a strong and tight repair probably is an extension of its use in basket mak-



Figure 221. Examples of recycled sherds: (a) Mesa Verde Ware handle ground smooth on both broken edges, (b) Dogoszhi Black-on-white jar sherd ground to a pendant shape, (c) Flagstaff Black-on-white shered with beveled edge, indicating use as a scraper, (d) Cibola Ware bowl sherd ground on the edges and concave side to form a disc, and (3) Tusayan Ware bowl sherd ground on the edges to form an oval and incised with a pattern commonly found on bone gaming pieces.

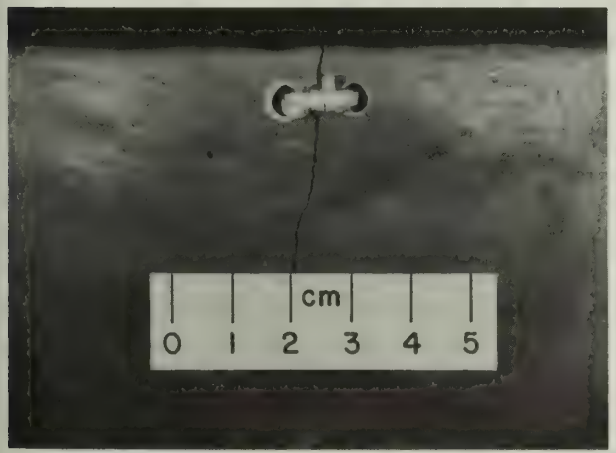


Figure 222. Outside view of rim of Puerco Black-on-red bowl from Burial 11 repaired with a binding of **Rhus trilobata.**

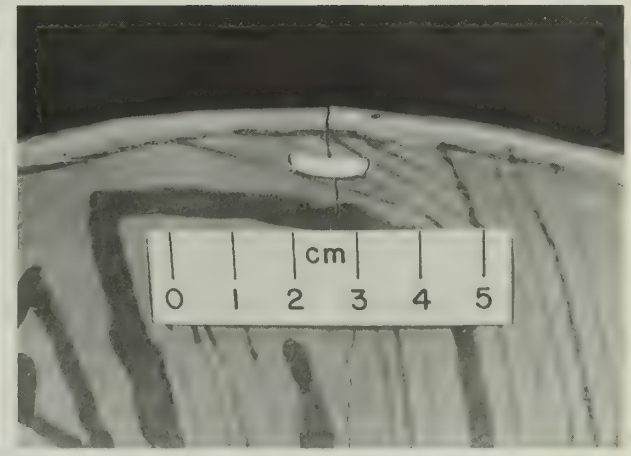


Figure 223. Inside view of repaired vessel from Burial 11.

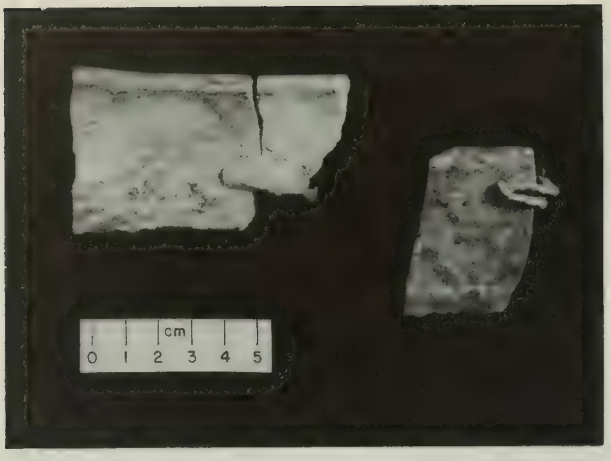


Figure 224. Cotton cordage repair on a Tusayan Black-on-white sherd (left) and yucca cordage repair on a St. John's Polychrome sherd.



Figure 225. An unidebtified Mesa Verde Ware ladle handle repaired with pitch and a **Salix** *sp. stick.*

ing; *Rhus* also is the primary material for basket repair at Antelope House. There are two repairs with *Yucca angustissima* cordage and one with cotton (*Gossypium hirsutum punctatum*) cordage (Fig. 224).

Pitch sometimes was applied to the broken edges of a vessel as a binder and smeared over the break on the outside. This technique was used alone on one jar from Burial 5 and in conjunction with repair holes and vegetal binding on a redware jar from the subfloor cist in Room 18 (Fig. 208). It also was applied over a yucca strip binding on a Sosi Black-on-white bowl from Room 29. Pitch was used to attach a broken handle to a Mesa Verde jar from Burial 11; although the handle is missing, the pitch remains (Fig. 213: d).

Ladles and mugs were amenable to use life extension if only the handles broke off. The stubs of the handle of a Mesa Verde Black-on-white mug (Room 30, 1193), for example, are ground down to the body of the mug. If the long handle of a ladle was broken, the end of the remaining stub was ground smooth. The same operation could be applied to successive breaks until the ladle cup finally succumbed. A unique case of extreme ladle repair is a specimen with a *Salix* sp. stick inserted into the remnant hole of the broken-off handle and secured with pitch (Fig. 225).

Defining and Testing for Value

It is hypothesized that the relative amount of repair is an index of the relative value of different types of pottery within the pueblo behavioral system (Rohn 1971: 189). Value is a difficult concept to apply to archeological data. Some empirical measures can be derived, however, from the economic anthropology of so-called primitive people. Value is variously defined by three criteria: (1) scarcity, (2) energy requirements for production or procurement and (3) sentiment (Malinowski 1922: 90, 162; Herskovitz 1952:232–236).

Scarcity is the most easily quantifiable measure of value for ceramics. It is based on the assumption that less available types are of greater value if demand is high. Here one must also assume that some of the typological differences we perceive in pottery also were perceived by the users. While it is impossible to determine what the actual relative frequencies of the standard ceramic type were at any one time, we can get some long-term indications by looking at the entire assemblage. Only Pueblo II-Pueblo III types are examined here, in order to eliminate at least some of the error of lumping the data and to eliminate the effects of temporal changes in the frequency of pottery repairs. Only types represented by at least 10 sherds are used, in order to minimize sampling error.

Figure 226 graphs the correlation of frequencies of types (X-axis) with the frequency of repair within the type (Y-axis). Mesa Verde Black-on-white and Mesa Verde ware of indeterminate type are lumped because of the arbitrary distinctions between the types. The White Mountain Redwares also are lumped because of the

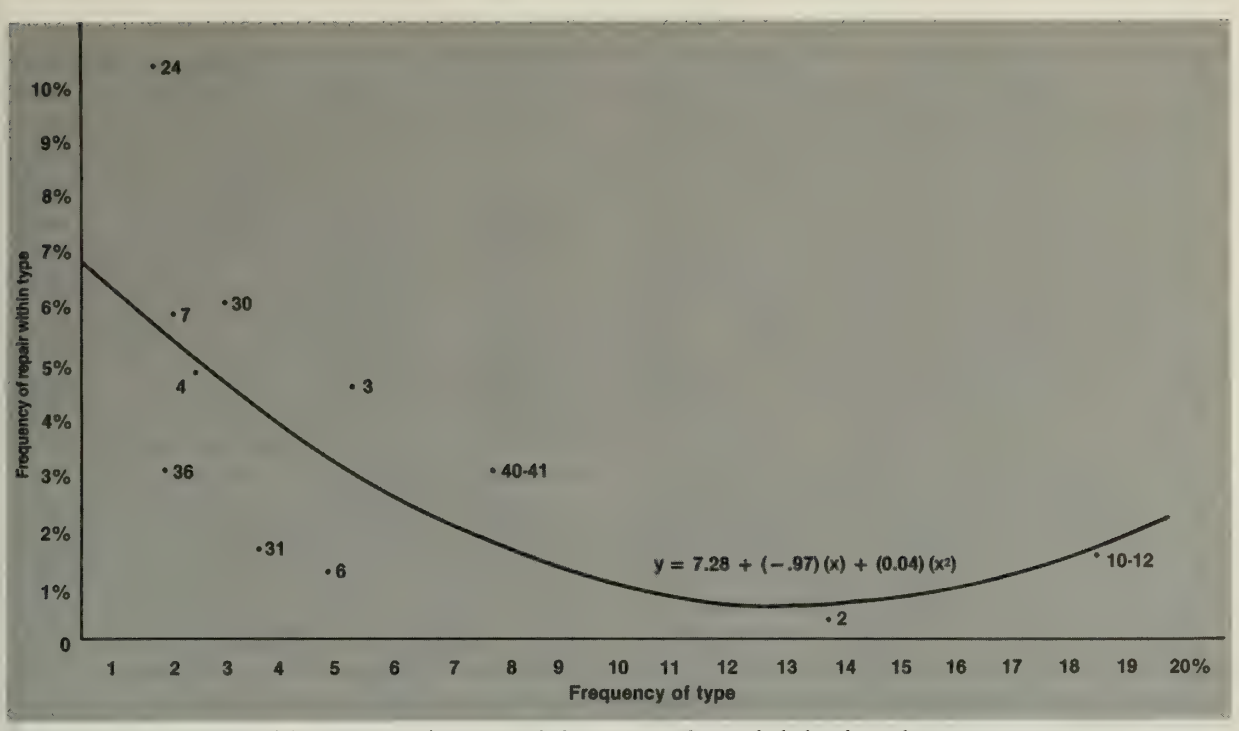


Figure 227. Correlation of frequencies of types with frequency of recycled sherds within a given type.

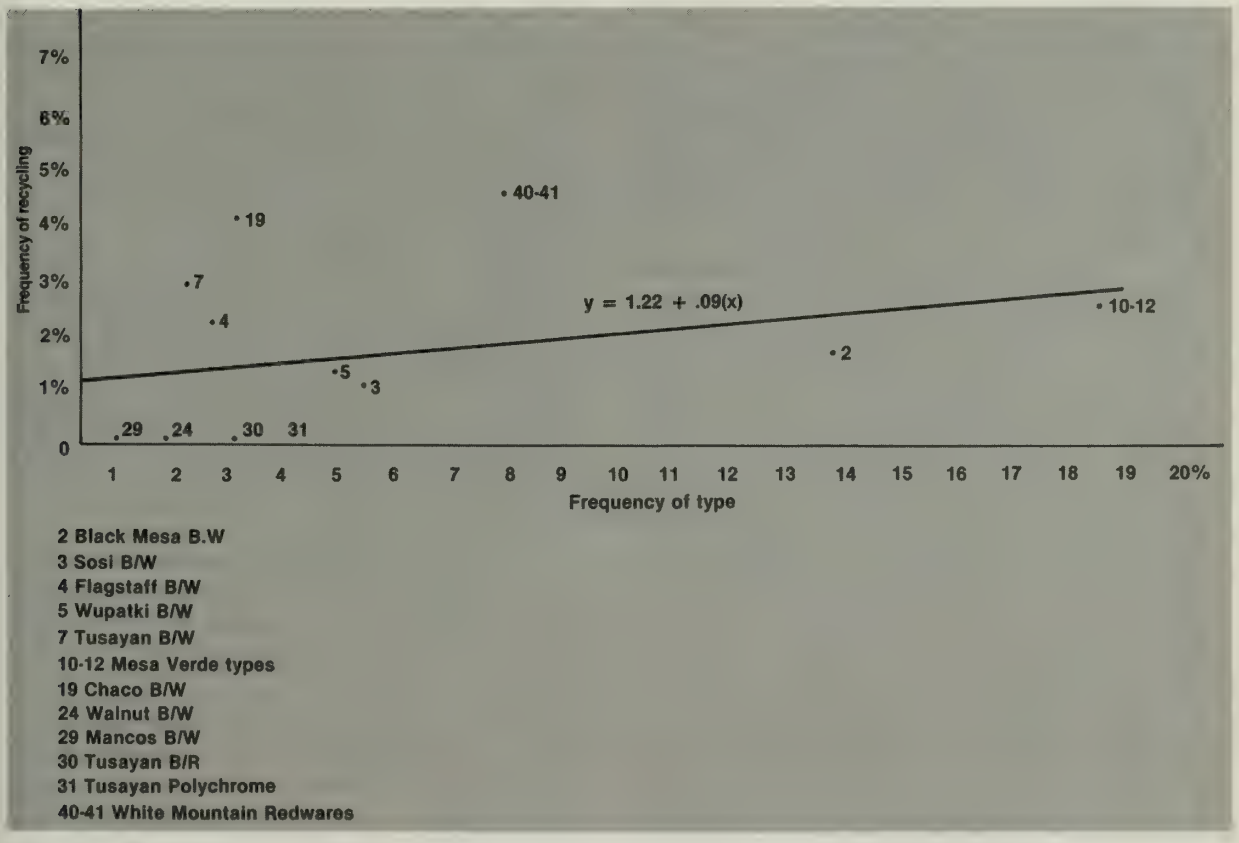


Figure 226. Correlation of frequencies of pottery types with frequency of repair within a given type.

extremely high frequency of repair of Wingate Polychrome and Black-on-red (14.3 percent). A value more in line with a parabola is produced by combining all the White Mountain Redwares, although Wingate alone has a highly significant correlation of scarcity and repair (making up only 9 percent of the decorated ceramics).

A clear non-linear regression relationship is produced, showing that the scarcest types also have the greatest percentage of repair. A parabolic curve is generalized from this data, using a non-linear regression: least squares fit analysis ($Y = a + bx + cs^2$).

As a control, recycled sherds are graphed in a similar manner in Figure 227. It was predicted and subsequently shown that types of sherds would be selected randomly (i.e., without regard to scarcity) for use as scrapers, discs, etc. If any pattern could be expected, sherds that were available for the longest time or in the greatest profusion would most likely be chosen over a long time span. The data provided a very slight (though probably insignificant) linear regression, which shows an increase in recycled sherds with increased relative abundance of the type. The low correlation coefficient, r + .297, was calculated from the data.

The correlation of repair with ceramic types as a measure of differential energy or sentimental value is a more difficult task because of the greater number of assumptions involved. We first hypothesized that certain wares, traditionally assumed to have been traded into Antelope House, would be of greater value than wares presumed to be manufactured locally. If traded vessels were acquired through barter, the cost in local goods of these hypothetical nonlocal vessels would be greater than would the energy needed to make the local variety. It would be highly desirable to hierarchically arrange wares or types according to the distance from locus of manufacture to locus of trade, with distance related to value, but this information is not available. There is little direct evidence that wares occurring in small frequencies at Antelope House and in greater frequencies in other areas are, in fact, tradewares. Those wares which fit this category are Little Colorado Wares (3.3 percent of decorated ceramics), San Juan Whiteware (0.8 percent), San Juan Redware (0.5 percent), Cibola Whiteware (12.8 percent) and White Mountain Redware (6.8 percent). Mesa Verde Wares (13.5 percent), however, are found in high frequencies in Pueblo III layers and constitute the most common type for that period. Whether it is a tradeware is a debatable point. Canyon de Chelly is in an area peripheral to all core areas of ware distribution (Colton 1955), making the discussion of tradewares even more difficult. Only Tusayan Whiteware (50.8 percent) and Tsegi Orangeware (7.2 percent), distribution of which coincides with Tusayan Whiteware, can be considered local because of the high frequency of Tusayan Whitewares at Antelope House. The core area of Tusayan Whiteware, as defined by Colton (1955), however, does not include Canyon de Chelly, but is north and west of it in the Kayenta district.

One can hypothesize some major typological distinctions, which should correlate with differences in acquisition and use. The wide geographical distribution of White Mountain Redwares has traditionally been attributed to their tradeware status (Carlson 1970: 31–41; Breternitz 1966: 93). St. John's Polychrome and Black-on-red are found in considerable quantities in Pueblo III proveniences at Antelope House (Appendix I). Wingate Polychrome also is found, although Carlson (1970: 17 ff) does not consider it to occur significantly in the Canyon de Chelly area. Whittlesey (1974) has argued that Four-Mile Polychrome, a later White Mountain Redware imported to Grasshopper Pueblo, is distinguishable from locally produced Grasshopper Polychrome by its intentional nestability for transport, thus providing some empirical verification of Four-Mile Polychrome vessels as tradewares.

Because tradeware might indeed have a set of uses within the pueblo behavioral system that is distinct from that associated with locally produced pottery, it is impossible to separate (1) energy for procurement from (2) differential use or sentiment as separate measures of value. In archeological analysis, they must be considered together.

Within the category of redwares, we must also consider the Tsegi Orangewares at Antelope House: Medicine Black-on-red, Tusayan Polychrome and Tusayan Black-on-red. Medicine Black-on-red is found in Pueblo I and Pueblo II periods, according to Colton (1955), and from Pueblo I to Early Pueblo III periods, according to Breternitz (1966: 99). Sherds of these types are found in small amounts, but with a high frequency of repair. Tsegi Orangeware has the same

Table 152. Decorated vessels from primary deposits.

	Field Specimen No.	Ware	Type	Color	Shape	(Comments)
(1) Burial 5 (319)	FS 193	WMR	Wingate	POL	Bowl	
	FS 192	TSW	Unidentified	B/W	Dipper	
	FS 191	TSW	Dogoszhi	B/W	Pitcher	
	FS 190	TSW	Unidentified	B/W	Pitcher	(repaired)
(2) Burial 11 (1258)	FS 1866	WMR	Puerco	B/R	Bowl	(repaired)
	FS 1871	MVW	Unidentified	B/W	Bowl	(repaired)
	FS 1874	MVW	McElmo	B/W	Jar	
	FS 1887	MVW	McElmo	B/W	Jar	(repaired)
	FS 1868	TSW	Unidentified	B/W	Bowl	("killed" in FS 1866)
	FS 1751	TSW	Flagstaff		Ladle	
	FS 1881	Plainware			Ladle	(in FS 1872, corrugated jar)
	FS 1869	Plainware			Ladle	(in FS 1866)
	FS 1867	TSW	Unidentified	B/W	Ladle	(in FS 1866)
(3) Burial (?), Room 44 (606)	FS 634	CIB	Reserve	B/W	Ladle	
(4) Burial 8, Room 48 (619)	FS 715	MVW	McElmo	B/W	Bowl	

general distribution as the Tusayan Whiteware and might, therefore, be considered the "local" polychrome of Canyon de Chelly. As with any other type found at Antelope House, there is no test, except paste analysis, to determine whether it was locally produced.

Repair as a measure of the greater value of redwares was confirmed by chi-square scores (Table 153). The null hypothesis tested is that relative ratios of repair of polychromes, redwares and black-on-white wares were due solely to chance. If this was so, the number of repaired sherds should be proportionate to the number of sherds in the assemblage. As might be expected, the polychrome and redware showed a significantly high association of repairs at the .05 significance level, thus rejecting the null hypothesis. Repairs of black-on-white wares could be explained, however, solely by chance.

Many of the repairs occurred in Tsegi Wares, which I had hypothesized to be local. This may indicate that the wares were traded into Antelope House, as were White Mountain Redwares, and/or that Tsegi Orangewares had special uses or value due to scarcity, which required extension of use life.

A test of Mesa Verde Ware yielded a chi-square score of 0.76, which is significant only between the 0.8 and 0.9 levels, causing me to accept the null hypothesis that observed repair is due to chance alone. This suggests that Mesa Verde Ware was not a tradeware, but was a common, locally-made, decorated ceramic in Late Pueblo III times.

Table 153. Chi-square figures—repairs.

		Repair	No. Repair	
Black-on-white	Expected	24.8	1898.2	
	Observed	18.0	1905.0	1923
Polychromes and	Expected	4.2	322.8	
Black-on-reds	Observed	11.0	316.0	327
		29	2221	2250
		$x^2 = 13.04$		

Utility ware sherds also show repair, but only in 14 of 9717 specimens. Worked utility sherds (11 examples) are equally scarce among utility sherds. Besides differential value, technical considerations, such as size, brittleness and uses requiring watertight and heat resistant repairs, may have discouraged repair of utility vessels. The crumbly fracture of many utility sherds also made them less efficient than decorated sherds for recycling or extended use life.

The differential use of ceramic types as an indication of value is not easily investigated at Antelope House. As noted, most ceramics come from secondary refuse deposits. Ceremonial functions for redwares and Mesa Verde Wares

are indicated in the few instances of *de facto* and primary refuse at Antelope House, but these are too few to be conclusive evidence for differential use and cannot be considered representative.

A possible ceremonial function can be attributed to a Medicine Black-on-red jar found in a subfloor cist in Room 18, a structure with the features of a kiva. It was repaired with *Rhus trilobata* bound through repair holes and sealed with pitch. Found with it was a McElmo Black-on-white jar.

A repaired St. John's Black-on-red bowl was among the many decorated vessels in Burial 11. It too was repaired with *Rhus trilobata*. All other vessels in the burial were plainwares or Mesa Verde Wares. Of the latter, a McElmo Black-on-white bowl was repaired with *Rhus trilobata* and the handle of a McElmo Black-on-white jar was repaired with pitch.

Temporal Aspects of Repair

Correlations of repair with dated ceramic types shows that the frequency of repair increased through time. Pueblo I types (Kana'a, Red Mesa and Black Mesa), especially, show low frequencies of repair. In addition to the high frequencies of repair among redwares, beginning in Pueblo II times, there is a noticeable difference between amounts of Pueblo I–II and Pueblo III repaired whitewares.

Adaptation to environmental stress is hypothesized as an explanation. If the energy required for producing or acquiring pottery increased through time, attempts to extend the use lives of these items should also have increased. Such a process can be observed in modern industrial societies, where in times of inflation, fewer new goods are bought and attempts are made to repair or maintain what is already available. A scarcity of fuel for firing pottery also is proposed, but no evidence for this sort of stress is found in the Antelope House vegetal remains. I also hypothesized that the time available for pottery production decreased as more time was devoted to subsistence tasks, but no evidence is available to test the proposal.

I found no evidence for increased pottery repair as an adaptation to environmental stress, but further investigation would be worthwhile. I also suggest consideration of other hypotheses, centering on changing social relations and on activities that might encourage extended use life of ceramic vessels.

Summary

Some empirical measures of the relative value of ceramic types are useful in ceramic analysis. Those discussed above indicate that greater effort was taken to extend the use life of decorated ceramics than of utility wares. Furthermore, redware and other relatively scarce types were repaired more often than were the abundant whitewares. Tradeware value needs further study, since we do not know about the trading system for ceramics. Did they use reciprocal trading, like the Trobriand Kula ring, or were itinerant craftspeople involved in a primitive marketing system? Value could be expressed differently in various trading situations, some of which may not even be represented in the ethnographic present.

Other classes of artifacts, which require relatively large amounts of energy to produce and which could be made from nonlocal materials, may also be amenable to this kind of analysis. Basketry, textiles and so-called ceremonial objects may show similar patterns of use life extension. Differential use attributable to special functions and relative scarcity seems to be reflected in the archeological data.

Painted Design Element Analysis

I employed a design element analysis of painted pottery to test the hypothesis that the architectural divisions of North, Central and South Room Blocks represent areas of separate but equivalent domestic groups. In other words, I expected to find specific design elements clustering in the three architectural divisions of Antelope House, each representing the spatially bounded loci for the production, use and discard of painted ceramics. The analysis of the archeological context of ceramics indicated that most of the ceramics would be found as trash, but the underlying assumption was that the ceramics were used and produced (or acquired from outside) in the same room block in which they were discarded. I expected some commonly used designs, due to exchange of pots and natural or human disturbances of archeological deposits, but I hoped that clusters would be evident on a quantitative level.

My results were inconclusive and unsatisfactory for a positive test of the research hypothesis. There probably are several reasons for this, including limitations in the data base and some of the assumptions behind the hypothesis, all of which are discussed below. It still is worthwhile to present the method of analysis and some of the resulting computer output, so that future researchers can avoid similar mistakes.

Method of Analysis

The design elements specific to Antelope House decorated ceramics were given code numbers in the order in which they were recorded. Lists used by Hill (1970a) and Longacre (1970) were employed for comparison of design elements, in order to establish a format and to lend some equivalency to the perception of elements. Sherds with incomplete or unrecognizable elements were omitted and only sherds from floor contact proveniences were used. Only Mesa Verde Ware sherds provide an adequate sample that is also evenly distributed among the room blocks. This analysis, therefore, applies only to Middle to Late Pueblo III times at Antelope House. One of the major problems with my analysis, of course, is the lack of sufficient quantities of sherds, as discussed above.

If we had not stratified our sample by period, we might have mistaken areas of temporally discrete pottery for areas of socially discrete residence. This would happen if we compared all the pottery in the South Room Block with all that in the North Room Block at Antelope House. Because of its longer occupation and better representation in archeological deposits, the south area has a higher frequency of Pueblo I pottery dated by a characteristic set of design elements associated with Kana'a Black-on-white, Red Mesa Black-on-white and other early ceramic types. The North Room Block, on the other hand, has a higher frequency of PIII pottery than does the South Room Block. Although the resultant bimodal clustering of elements might be mistaken for a bi-modal residence pattern of potters, the observed difference might actually be attributable to the history of settlement at the site.

Because of the subjective and arbitrary nature of the task (Tuggle 1970), a single researcher recorded the design elements in our study, increasing the probability of consistency in data collection. The standard Southwest pottery type designations and form classes were recorded along with each design element; data from the Earl Morris collections from Canyon del Muerto at the American Museum of Natural History were included. All of the data are permanently filed in the SELGEM system at the University of Arizona.

More than 320 different design elements from all types of pottery were identified, compared with the 57 found by Hill at Broken K (1970). This probably is due to the long span of occupation at Antelope House and to the correspondingly larger number of ceramic types produced or traded in. Thirty-four Mesa Verde Ware design elements, each with at least five occurrences in the site, were used. Only rooms with at least five usable design elements were included in the sample. Illustrations of all design elements are on file at the Western Archeological Center.

The smallest space analysis of partition (SSAPI) from the Guttman-Lingoes series was applied to a coefficient matrix in order to find clusters of rooms based on common design elements; these, I hoped, would correlate with room blocks. This technique was chosen over standard factor or cluster analysis because it deals with nominal data without making the invalid assumption that the data exhibit interval scale properties (Lingoes 1970: 278). Design elements, which are nominal data, are appropriately analyzed with this technique. Smallest space analysis also produces a graphic representation of the association of objects in three-dimensional space. These plots are easily interpreted because the Euclidian distance of the computer-generated lines plotted in a three-dimensional space is directly proportional to the degree of association of the objects the lines represent (Lingoes 1970, 1973). Thus, those rooms that cluster in one area of the plot share more common elements than other rooms distributed in other areas of the plot.

The results presented here are not to be considered either absolute verification or invalidation of the research hypotheses, but rather as an aid for future applications of this technique and a stimulus for the formulation of alternative hypotheses.

The Q-mode COR 3 NOM subroutine (Guttman-Lingoes association coefficient for qualitative data) produced the most definitive clustering of rooms. The IOTA subroutine (iota coefficient)

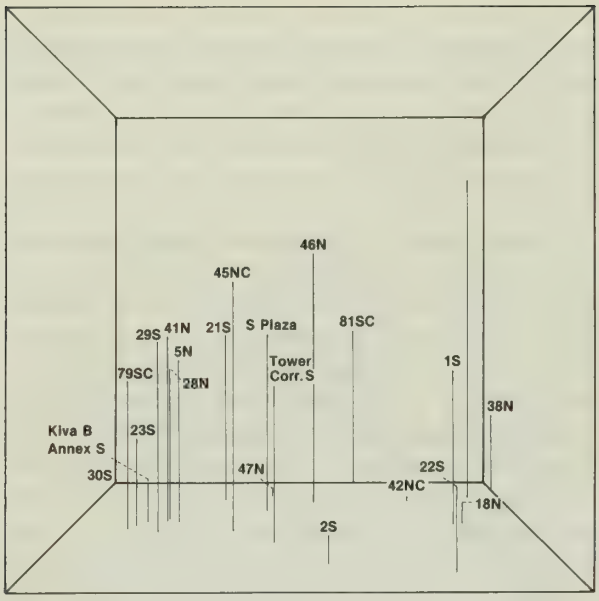


Figure 228. Clusters of rooms with pottery design elements in common, derived by smalles space analysis of partition (SSAPI).

and the Brainerd-Robinson Agreement coefficient provided the least satisfactory results. Only the COR 3 NOM is presented here, although about 15 runs were made; these are on file at the Western Archeological Center.

The densest cluster of rooms is in the lower left corner (Fig. 228). The room number and room block designations are beside each line (N = North Room Block, S = South Room Block, NC = north half of Central Room Block and SC = south half of Central Room Block). Some associations are quite predictable, such as Kiva B annex with Rooms 23, 29 and 30 of the South Room Block. Rooms 5, 28 and 41 of the North Room Block also share some design elements with the southern rooms as a whole. Room 79, originally designated part of the Central Room Block, clusters with the southern rooms, indicating that a north-south division of the site may be more appropriate than a tripartite division. Other associations of north rooms (17, 18, 38 and 42) with southern rooms (1 and 22) are equally perplexing. Rooms in the center of the plot show the least tendency to cluster in a predictable manner.

The association of the South Plaza, Tower Corridor and Room 47 (a trash-filled kiva) in the center of the plot is understandable, as these proveniences seem to be areas of intentional trash disposal. The South Plaza and the Tower Corridor are adjacent open spaces and produced some of the largest numbers of late Pueblo pottery in secondary refuse contexts. Room 47 was filled to the brim with debris, in which Mesa Verde Wares constitute the predominant ceramic type. Large numbers of sherds were found on the floors of Room 47 and the South Plaza, in particular. The median positions of these proveniences on the plot indicate that they share design elements with rooms on either side. This can be interpreted as due in part to the larger samples of ceramics in these proveniences (and, therefore, the larger number of design element associations with other proveniences) and in part to the greater number of activity areas from which these trash deposits may have originated.

Among the reasons for the anomalous clusters are the kinds and distribution of design elements chosen, among which are 12 designations for painted straight lines and negative spaces between parallel lines. Since the width of a line is a continuous variable, I divided the designation into lines of 0–1.0 mm, 1.1–2.0 mm, and so forth, up to 5.1–6.0 mm and larger. Six designations for negative lines also were made, using the same interval scale. These lines are so common, however, that there is no variability in their occurrences from room to room. They are equally numerous in every area sampled. This lack of variability inhibited the smallest space analysis from producing clusters based on the other, less common design elements. I found that better results were obtained by discarding elements that did not have significantly varying frequencies between the North and South Room Blocks, but this further limited the number of sherds and design elements I had to work with; it also produced an artificially skewed sample.

A much more serious set of problems in the analysis involves the basic assumptions underlying the use of design elements as indicators of social groups; a lot of ink, as well as bile, has been spilled on this subject (Hill 1970a; Longacre 1970; Allen and Richardson 1971; Stanislowski 1969; Bartovics 1974: 202–203). The technique is methodologically sound and explicit, and further research will clarify the relationship between the locality of potters and the clustering of design elements (Longacre 1975); but some of the assumptions concerning the archeological context of ceramics and their relationship to behavioral

systems must be questioned and researched (Schiffer 1972).

Analytical Problems

Now we must consider the reasons for the inadequate results produced by the application of SSAPI to the design elements of painted ceramics at Antelope House. First, there simply are not enough sherds from critical proveniences to produce an adequate sample of recurring design elements. Most elements could not be used, since they occurred only once or twice, and many rooms could not be used, since no recurring design elements were found on sherds from their floors. It would have been desirable to sample trash deposits from specifically dated trash proveniences; if our assumption that the location of production, use and discard of ceramics remains constant is valid, then trash deposits would be as useful as the "critical proveniences" on floors. Another problem is that many archeological remains at Antelope House are trash deposits that are disturbed both horizontally and vertically. Communal trash deposits may mix artifacts produced for, and used by, many distinct social groups. Cases in point are the kivas at Antelope House that seem to have been intentionally filled with rubble. This would help explain the anomalous association of Room 47 in the North Room Block with the South Plaza and southern rooms on the SSAPI plot. Objects on floors may not necessarily be *de facto* refuse associated with activities on these floors; they may be discarded trash from other areas of the site. Thus cultural and natural transformation processes may be operating on enough of the archeological record to prevent discovery of the hypothesized nonrandom artifact distributions.

Unanswered Questions

Some basic questions could not be answered with our ceramic data: What pottery was locally made and what was traded into Canyon de Chelly? Do ceramics demonstrate migration into Canyon de Chelly during Pueblo III times? These questions must be confronted and it is my hope that this study will stimulate further research.

Unlike Chaco Canyon (Judd 1954), Mesa Verde (Rohn 1971), or the upper Little Colorado area (Longacre 1964), no geographically specific ceramic assemblage characterizes Canyon de Chelly. Steen (1966: 115) describes Canyon de Chelly as a social backwater, which borrowed from surrounding dominant cultures. De Harport (1959: 1576) goes as far as to assume that all pottery, both decorated and utility, was traded into the canyon because his survey located no identifiable manufacturing areas. Both of these interpretations are based on untested assumptions and on unstated criteria related to the meaning of the geographical distribution of pottery types. It seems unsound to consider Canyon de Chelly a cultural wasteland simply because it is difficult to establish the local ceramic types. Colton (1955, 1956) does not include Canyon de Chelly in the core area for any of the northern Arizona pottery types, all of which occur mainly to the north and west. Recent updates of the Mesa Verde Ware descriptions, however, include both Canyon de Chelly and Chinle Wash within the core area (Breternitz *et al.* 1974). What, then, are the local and tradewares of Canyon de Chelly at a given time and what criteria are to be used to identify them?

Some pottery was locally made; many unfired and miniature clay vessels, indicative of local ceramic production, were found at Antelope House. Raw clay, polishing stones and sherd scrapers are further evidence of pottery manufacture at the site. The criterion most often used for defining local types is numerical predominance; those types occurring in low frequencies are designated tradewares. The correlation between use life extension and the low frequency of occurrence of certain types at Antelope House, especially of polychromes and redwares, tends to support this view. However, for the independent verification of local and nonlocal identifications, the micro-analysis of paint, temper and paste will be necessary (Shepard 1956: 165; Weymouth 1973).

A second question concerns the possible migration of new populations into Canyon de Chelly during Pueblo III times. I have already shown the abrupt and extensive appearance of Mesa Verde pottery in the Pueblo III assemblage. Given the assumption that the predominant pottery types are locally produced, is there evidence here of groups moving into the canyon from the Mesa Verde area? This is an important question because the ceramics might suggest population movements just at the time environmental degradation is postulated in the Southwest. Thus the movements of specific sedentary agricultural

groups may have been an important factor in subsequent abandonments of entire host regions during the Great Drought. Could local environmental stress have been accelerated by new groups moving into Canyon de Chelly? Before we can answer the more important questions concerning the relationship between human adaptation and population distributions, we must demonstrate that a migration occurred. There are, after all, other possible explanations for Mesa Verde Ware at Antelope House: (1) increased trade with the Mesa Verde region, (2) itinerant potters, or (3) the stimulus diffusion of Mesa Verde styles to local potters.

Haury (1958) reports the most convincing model for the demonstration of population migration. A whole complex of new stylistic and technological traits was found at Point of Pines, indicating a migration to the site from the Kayenta-Hopi region. Included in the assemblage are nonlocal pottery types made with local temper, intrusive secular and religious architectural styles, intrusive varieties of corn and squash and nonlocal artifact types.

While the Antelope House ceramics show the change in ceramic styles, the predominant sherd temper with secondary amounts of rock or sand is entirely within the expected range for Mesa Verde Wares (Breternitz *et al.* 1974: 41, 45). Sherds are the principal temper and sand is the secondary temper in Mesa Verde pottery from all parts of the site. Upon further examination, however, the chemical composition of the material may prove to be local.

Following Haury's criteria, there are no new ceremonial or domestic architectural styles at Antelope House that might be associated with the Mesa Verde region, but there is a shift in community settlement pattern in PIII times. De Harport reports intrusive architectural styles in other parts of Canyon de Chelly, such as Chacoan masonry styles at White House Ruin and Site CC101 and Mesa Verde styles at Mummy Cave and Site CC47 (1959: 1579–1580). There is some circumstantial evidence, therefore, for population migration into Canyon de Chelly in PIII times. Such an interpretation at Antelope House, however, would have to be based on ceramic criteria alone. The Late Pueblo III masonry construction phase at Antelope House is not at all like that of the Mesa Verde region. Kivas are built in the same fashion as before and habitation rooms are more poorly constructed than in Pueblo I or Pueblo II times.

It initially was hoped that the comparison of Pueblo II and Pueblo III ceramic design elements would provide some evidence of changes in the structure of social groups or behavior that could reflect the immigration of new groups, but the paucity of pre-Pueblo III ceramics and the lack of *de facto* refuse inhibited such attempts. These questions, therefore, must remain open for the time being.

Unfired and Miniature Clay Objects

Unfired clay and adobe figurines, bowls, geometric shapes and unidentified objects were found at Antelope House. All of these objects were examined, not just those in critical proveniences. Some provide important insights into activities that are not reflected in the less perishable artifact remains, but some of the following discussion must remain on the level of speculation until similar objects are found in greater quantities and in more revealing archeological contexts at other sites. The objects have been grouped according to form in most cases, since the function often is questionable. Because no artifacts in this category are in the SELGEM file, all relevant information is reported here.

Anthropomorphic Figurines (Fig. 209)

The clay figurines at Antelope House represent more than the recorded range of variation for northeastern Arizona.

Basketmaker III

Figurines a, b and c in Figure 209 are most diagnostic of Basketmaker III; others like them have been found in other parts of Canyon del Muerto (Morris 1927), in the Prayer Rock district (Morris 1951), in the Tsegi region (Guernsey 1931) and in the Mesa Verde region (Morss 1954). These early figurines are characterized by a flat, oval shape formed in smooth unbaked clay, by protruding nose and breasts, by slit eyes, by incised nose (b and c) and mouth (c) and by a crotch slit. Each has a necklace represented by rows in incised dots. These figurines belong to Morris' (1951) Style III, which he dated from AD 475 to 675. Item c, however, is from Room 67

and is later than AD 675. It was found as *de facto* refuse on the floor of a burnt Basketmaker III structure, definitely dated to AD 695–771 by treering and archeomagnetic methods. Items a and b also were found in Basketmaker III proveniences and indicate a later date for the Basketmaker complex.

Item d is a female figurine without the details of a, b and c. It is smooth and oval, with protruding breasts but without a crotch slit. The upper portion is broken, so that it is impossible to tell how much of the face is represented. There is an impressed hole at the bottom of the break that may be a nostril or a mouth.

Item e has no sexual characteristics, but it has the oval shape, regular surface and protruding nose of the figurines mentioned above.

Items d and e fall into Morris' Style II of Basketmaker III figurines. These, however, were found in Pueblo I and Pueblo II trash deposits, respectively. They may be later expressions of Basketmaker III styles, using simpler modeling, or they may be temporally out of place, as is common in secondary refuse deposits.

Post-Basketmaker III

Items f and g are of a style that has not been previously described. They are most similar to Morris' Style IV, but they are much more abstract. Like Style IV they have a clear demarcation between head and body. Although the body of f is missing, it is presumed to be similar to that of g, but on a larger scale. The heads are square and only a beak-like nose protrudes from the top. The body of g tapers from the neck and has no sexual characteristics. As with the previous figurines, the surface is carefully smoothed on the front and back.

Items f and g cannot be assigned to the Basketmaker III category on the basis of style, a decision supported by the Late Pueblo III dates of the proveniences.

Items h, i, j and k also have differentiated heads and bodies, as well as more anatomical detail than f and g. They are similar to Late Pueblo specimens from Chaco Canyon (Judd 1954).

Item h is more rectangular than oval, with a smoothed but irregular surface and a sandy core. There is no face and the only anatomical features are the protruding and pointy breasts and a punched hole to denote organs or navel.

Item i has a spatula-shaped head and a rectangular body, which tapers at the bottom. It is thickest at the center near the breasts, which have been broken. It has simple punched holes for eyes and an incised mouth. The navel or sex organs are presented by a punched hole. It is similar to h in shape and in the more uneven surface treatment.

Item j is very crude and may not be a figurine. It has the same general shape as h and i, but the only anatomical features are two dabs stuck on to indicate breasts.

Item k was bent and broken while still malleable and was burned before completed. It resembles i in shape.

Item l is broken just above the point where it flares out to form the head. A punched hole is visible at the break, probably representing the mouth. It fits into the same group as h and i, but it evidently lacks a navel.

Stylistic Trends

There is greater variability in style of post-Basketmaker anthropomorphic figurines at Antelope House than previously was reported for surrounding sites (Morris 1954; Rohn 1971), but the collection supports some generalizations about figurines in the Southwest:

1. There is a relative decrease in occurrence of figurines after Basketmaker times. While there are about as many Basketmaker III figurines as Pueblo period figurines in absolute numbers, the number of Basketmaker III figurines per provenience is greater.

2. The Basketmaker III and Pueblo figurines each have a distinctive set of stylistic traits by which they can be separated. The former are more realistic, more carefully molded and more homogeneous. The latter are generally less well modeled and fit the babe-in-cradle style of the Pueblo III Kayenta series (Morris 1954). This differentiation thus can serve as a subsidiary dating service.

3. Female figurines predominate over male or indeterminate ones through time. The large numbers of later figurines with breasts have not been reported in the literature, however.

Function.

None of the Antelope House figurines were found in archeological contexts or associations that give conclusive evidence of their function.

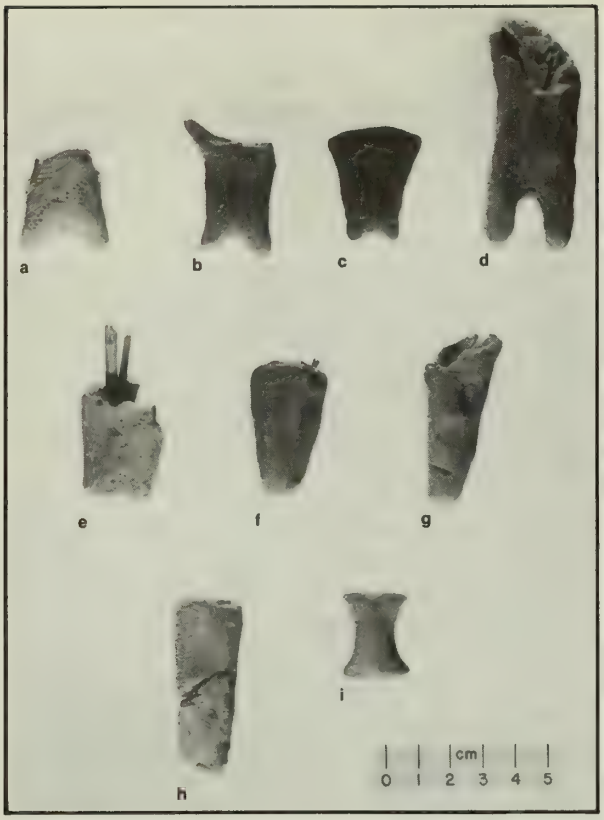


Figure 229. Cone-shaped (a-h) and reel-shaped (i) clay objects from Antelope House (see text for description and discussion).

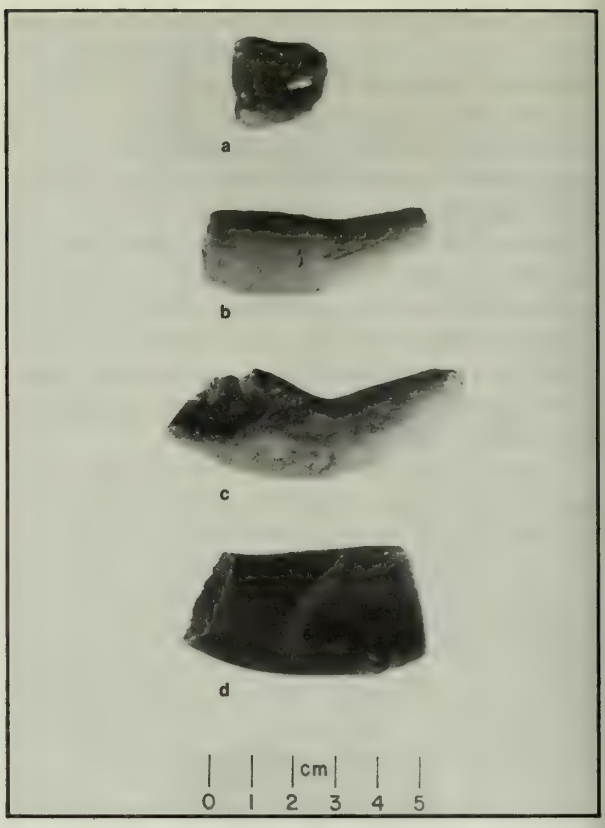


Figure 230. Fired and unfired clay pipes from Antelope House (see text for descriptions and discussion).

Cradle Models

Items m and n (Fig. 209) are models of cradles with the typical hoods that protect a baby's head. The pieces of clay representing the backboards on both of these specimens have been broken off.

Item m has been burned or intentionally fired; n is unfired. The spatula-shaped space formed by the hood on both specimens is exactly the shape of the heads of Figurines i and j. Both cradle models come from Pueblo III proveniences. Similar contemporary examples of the babe-in-cradle complex are found in Chaco Canyon and in the Kayenta district (Morss 1954).

Cone-Shaped Clay Objects (Fig. 229 through 232)

The 12 cone-shaped objects from Antelope House are less well understood than are the figurines of life forms.

Items a through d (Fig. 229) are "bifurcated basket" forms modeled in unfired clay. Item a, the only decorated specimen, has incised triangles filled with hatching or punched dots. The broken top shows evidence of being hollowed. Item b is much like Item a, but is undecorated. Both sides are indented slightly. Item c is the only complete bifurcated form. The elongated hollow cavity at the top was punctured five times at the bottom while still soft. The piece later was burned in a smokey fire. Item d has the roughest surface treatment, bearing the remains of six *Acer negundo* (box elder) twigs stuck in the hollow opening at the top.

It is reasonable to suggest that Items a through d are models of bifurcated carrying baskets. The vegetal material stuck in one, and evidently in another, may be representations of their function as receptacles. As with the life form figurines, it is impossible to determine whether they are religious objects or playthings. Morris and Burgh (1941) and Morss (1954) contend they were part of a fertility cult, since they frequently are associated with anthropomorphic figurines in Basketmaker III times. At Antelope House, only Item a is associated stratigraphically

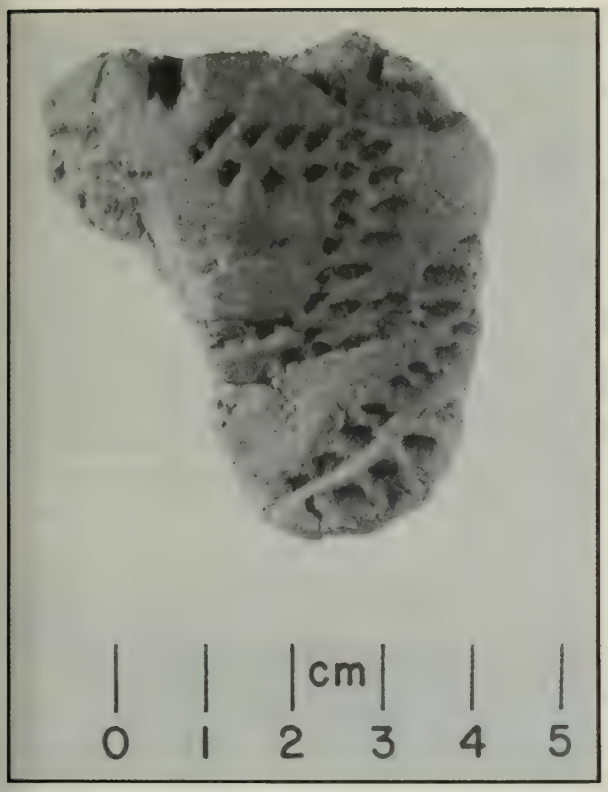


Figure 231. Side 1 of a clay object of unknown function. It originally was part of a wider and thicker object.

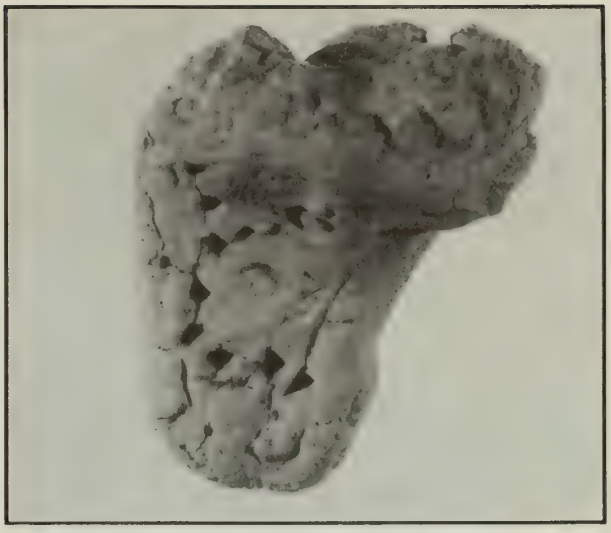


Figure 232. Side 2 of the clay object pictured in Fig. 231.

with a human figurine. Cone-shaped object a also is the only one from a possibly early Pueblo provenience, although all date to post-Basketmaker III times.

Item e was conical, but is now broken at both ends. It had three or four twigs of *Salix exigua* (coyote willow) stuck into it, two of which remain.

Item f is a solid, cone-shaped object with indented sides. It does not belong to the same category as do Items a through d, but it has holes in the top where sticks were pressed into the wet clay; one of these sticks, possibly *Acer negundo*, is stuck into the cavity.

Cone-shaped Item g has a hollow cavity, as do Items a through d. A twig of *Acer negundo* is in the cavity.

Item h is a flattened, unfired clay object and is broken at both ends.

Item i is a reel-shaped, unbaked clay object, which evidently was attached at one end to another piece of clay. It may be a model of a square basket.

Item a (Fig. 230) is the broken bowl of a pipe or cloud-blower. The funnel-shaped bowl is punctured at the bottom where the stem has broken off. It has been fired and has a crumbly core and carbon streak.

Item b is a pipe or cloud-blower of unfired clay. The outside and the inside of the bowl are carefully scraped. The bowl is long, taking up the thickest section of the pipe; the thin section is pierced through to form the stem. There is no sooting of the bowl to indicate use.

Item c is a burnished, sherd-tempered and fired pipe. Its bowl is shaped much like those of the above specimens, but the angle between the stem and the bowl is more acute. The bowl is sooted, indicating use. This pipe was in a *de facto* or primary refuse context inside a corrugated vessel found in a stone-lined cist in Floor 3, Room 29.

Item d also is sherd-tempered, burnished and fired. This pipe was burned after it was broken just below the bowl. It was found on Floor 3 of Room 29 and may have some association with Item c, possibly indicating primary or *de facto* refuse from a ceremonial activity area.

The object illustrated in Figures 231 and 232 is flattened at one end and broken at the other, where it formed part of a wider and thicker object. It is uncertain whether it was a figurine, a model of a vessel or something else. A zigzag design formed by two rows of oblique holes was punched into Side 1 and a single line was incised, along with a row of punched holes, around the periphery of Side 2.



Figure 233. Side view of an unfired clay figurine of a large carnivore, possibly a bear or cat.

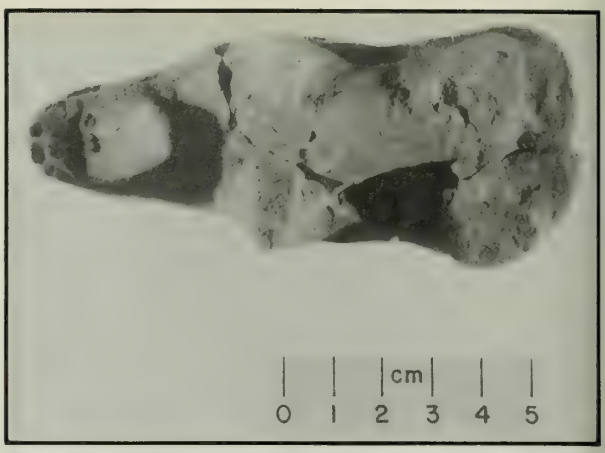


Figure 234. Bottom view of the zoomorphic figurine pictured in Fig. 233.



Figure 235. Zoomorphic figurine of fired clay from Burial 17.

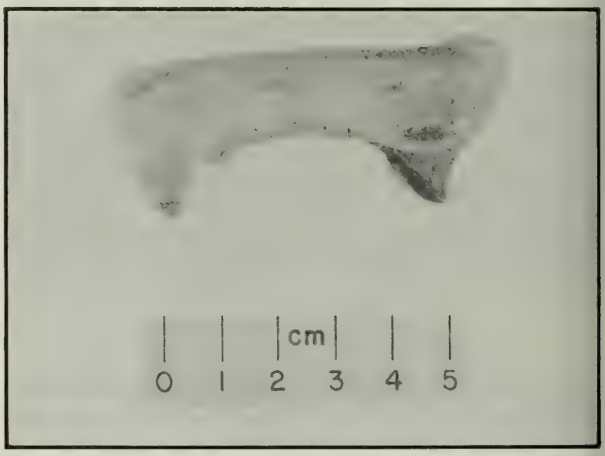


Figure 236. Another view of the zoomorphic figurine from Burial 17, a child burial. The figurine may have been a plaything.

Zoomorphic Figurines

Zoomorphic figurines also are in that class of objects whose function is a puzzle. All seven apparently are mammalian, but their state of preservation limits the accuracy with which they can be identified.

The first figurine (Fig. 233 and 234) is a fierce representation of some large carnivore, possibly a bear or cat. It is made from unfired clay, has eyes of oak charcoal (*Quercus* sp.) and three teeth of willow sticks (*Salix* sp.) in each jaw. The nostrils are formed by two punched holes and the anus is represented by a large funnel-shaped hole. There also is a small hole under the anus, which presumably marks this figurine as female. All the legs are broken.

The second is a fired clay figure with fine sand temper and white slip; it is painted in the Flagstaff Black-on-white style. The protruding ears or horns are worn down somewhat, so that it is difficult to determine whether it is an ungulate or other mammal. The figure may have been attached at the legs to a vessel handle or rim.

The third (Fig. 235, 236) also is fired and has crushed rock and sherd temper. It has a polished white slip but no painting. It was broken at the neck and tail(?), but was ground down to extend its use life. This explains the carbon streak appearing on the surface at either end. The legs also were broken, but the stubs were not ground smooth. This is the only zoomorphic figurine

Table 154. Jar stoppers.

Specimen	Provenience	Thickness	Approximate Diameter of Jar	Impression
1	F5 45/122	3.4 cm	16 cm	corn cob
2	Rm 22/1188	2.1 cm	8 cm	corn cob
3	Rm 23/1404	3.3 cm	18 cm	corn cob
4	H4 61/262	2.7 cm	18 cm	corn cob
5	Rm 50/626	5.5 cm	10 cm	none
6	Rm 29/1318	3.8 cm	16 cm	herbaceous plant (*Populus* sp.)
7	H5 55/264	2.0 cm	18 cm	Utah juniper

found in primary refuse context which also provides independent data on function. The figurine was part of the furnishing of Burial 17, found in a cist between Rooms 4 and 80. It is a child burial, so that the figurine may have been a plaything. Only one decorated sherd is associated (Cortez Black-on-white) and it was made in the Pueblo II period (Breternitz 1966). This type has a rock temper identical with that of the figurine, which helps support the association and date.

The fourth is a head of unfired clay, with eyes of charcoal (coniferous sp.). The long snout and short ears are indicative of a mammal.

The fifth is the hind section of an animal. The underside is impressed along its length and a tiny hole is punched at one end to indicate the anus. The hind legs are reminiscent of modern pueblo stone fetishes.

The sixth is a fired clay (or soft stone) animal fetish from the Pueblo I trash fill in a jacal structure (St. 74) in the South Plaza. It closely resembles the "Coyote-Hunter of the West" fetish of the Zuni Indians (Cushing 1883). It has a long drooping tail, small pointed snout, erect ears and drilled eyes and anus. This specimen has an upturned head, which is unusual. If this figurine is not intrusive into the strata, it represents a very long tradition of fetish making in the Southwest.

The seventh is the most ambiguous piece and may not actually be a zoomorphic figurine. It is modeled from a heavy piece of sandy clay. The piece is heavily worn by water or by handling and lacks diagnostic features. The head (if it is a head) is square and has a small nose or beak. It protrudes from the side of a larger rectangle and is relatively flat on the bottom.

Adobe Jar Stoppers

Seven unfired adobe jar stoppers (see Table 154) were found at Antelope House. Four of them bear impressions of corncobs on their inner sides. The fact that these are impressions of cobs, rather than of ears, indicates the method of manufacture and the specific function of jar stoppers. Jars were filled with discarded corncobs; wet adobe was then pressed into the opening and the top was smoothed over. When the adobe was dry, the cobs and stopper could be removed and the stopper replaced with the assurance of a tight-fitting, protective cover for the stored goods. If the wet adobe was to act as a seal for long-term storage, corncobs could be placed over the foodstuffs in the jar to protect them from the wet mud. These corn-impressed stoppers should not be assumed to have covered jars of ear corn. Only one corrugated jar of ear corn is known from Antelope House and it was covered by a stone slab (Fig. 237).



Figure 237. Ear corn cached in a corrugated jar originally covered with a stone lid. The vessel was recovered from the South Plaza by F.M. Palmer in 1906. Its date is uncertain, but may be PII or PIII.

Table 155. Unfired and miniature clay vessels.

No.	*Provenience*	*F.S. No.*	*Form*	*Mode of Manufacture*	*Whole or Fired?*
1	Rm1/317	211	bowl		whole, fired (well made)
2	Rm1/1322		—		— , —
3	Rm5/896		bowl		— , fired
4	Rm5/896		bowl	coil	— , —
5	Rm5/1120	1419	bowl	pinchpot	whole, —
6	Rm17/565	692	pitcher		— , —
7	Rm18/562			pinchpot	— , fired
8	Rm18/570	489	bowl	pinchpot	whole, —
9	Rm18/1143	critical	bowl		— , fired
10	Rm21/319		bowl		— , fired
11	Rm21/319		jar		— , fired
12	Rm21/319		—		— , fired
13	Rm21/319		bowl		— , fired
14	Rm21/319		—		— , fired
15	Rm21/319		jar		— , fired
16	Rm21/338	369	bowl?	coil	— , — (full size)
17	Rm21/368		bowljar	pinchpot	whole, —
18	Rm21/379	261	pitcher		whole, —
19	Rm22/1188		bowl	coil	— , —
20	Rm23/1540		seedjar	coil	— , — (full size)
21	Rm27/240	692	pitcher		— , —
22	Rm29/1254	1234	jar	pinchpot	whole, fired
23	Rm29/1264		bowl	pinchpot	whole, fired
24	Rm29/1269	1849	bowljar	pinchpot	whole, —
25	Rm29/1269	1859	bowl		whole, —
26	Rm29/1318	2024	seedjar		whole, — (corn husks)
27	Rm29/1318	2063	jar		whole, —
28	Rm29/1318	2059	jar	pinchpot	whole, —
29	Rm29/1318		ladle		whole, —
30	Rm29/1318		—		— , —
31	Rm29/1318		bowl	coil	— , — (yucca cord attached)
32	Rm30/1189		bowljar	pinchpot	whole, —
33	Rm30/1257	1275	bowl	pinchpot	whole, —
34	Rm32/730		handle?	slab	— , —
35	Rm35/478		ladle	slab	— , —
36	Rm38/1575		bowl	coil	— , fired
37	Rm43/583	812	bowl	coil	whole, —
38	Rm44/595		bowl	pinchpot	— , —
39	Rm45/610		jar	pinchpot	whole, —
40	Rm46/601		bowl	coil	whole, —
41	Rm47/604		ladle	pinchpot	— , —
42	Rm47/1152		jar	pinchpot	whole, —
43	Rm47/1155		dish?	—	— , —
44	Rm57/768		ladle	—	— , —
45	Rm58/1083		seedjar	coil	— , —
46	Rm67/1102	1342	bowl	coil	— , — (full size)
47	Rm70/1106		ladle	pinchpot	— , —
48	Rm70/1106	1357	bowl	pinchpot	whole, —
49	Rm70/1109	1816	bowl	pinchpot	whole, —
50	Rm71/1119	1386	bowl	—	whole, — (burnt)
51	Rm89/1328		seedjar	coil	— , —
52	Rm89/1328		bowl?	—	— , —
53	Firepit S of Rm28/461	163	jar	pinchpot	whole, —
54	KBA/217		jar	—	— , fired (corrugated)
55	KBA/755		bowl	—	— , —
56	KivaC/286	1476	jar	pinchpot	whole, —

Table 155. Unfired and miniature clay vessels—Continued

No.	Provenience	F.S. No.	Form	Mode of Manufacture	Whole or Fired?
57	KivaD/155	1341	ladle	pinchpot	— , —
58	KivaD/170		bowl	—	— , —
59	E of Rm18/558	544	ladle	pinchpot	whole, —
60	E442/157	1332	bowl	pinchpot	whole, —
61	E443/157	1323	jar	pinchpot	whole, — (burned)
62	D3/1417		bowl	pinchpot	— , fired
63	F141/155	1367	—	pinchpot	— , — (decorated)
64	F2–F431/178		—	—	— , —
65	G141/314		bowl	pinchpot	whole, —
66	G152/122	1686	bowl	pinchpot	whole, —
67	G252/123	1907	bowljar	pinchpot	whole, —
68	G254/122		bowl	pinchpot	— , fired
69	H161/263		jar	—	— , fired
70	I554/263		bowl	pinchpot	— , fired
71	K144/219		bowl	coil	— , —
72	K161/216		bowl	—	— , fired
73	K251/219–220		bowl	pinchpot	— , fired
74	K252/231		bowl	pinchpot	— , fired
75	L443/000	1968	bowl	pinchpot	whole, —
76	L55/216		bowl	—	— , —
77	N1–N442/905		bowl	—	— , —
78	N241–43/895		—	—	— , —
79	N344/922	1128	jar	pinchpot	whole, fired (painted)
80	N344/934		bowl	coil	— , —
81	N412/002		ladle	—	— , fired
82	N445/963		bowl	pinchpot	— , fired
83	N544/1101	1335	bowl	pinchpot	whole, —
84	P33–P34/905		bowl	—	— , —

Other materials also were used for insulation. Item 6 (Table 154) is a jar stopper bearing impressions of a woody material. Finger impressions made when pressing the wet adobe into the jar remain on its upper surface. This specimen is associated with a number of unfired miniature clay vessels (discussed below) and may have been derived from the same raw material source. Item 7, a complete stopper, is similar to Item 6, but *Juniperus osteosperma* (Utah juniper) bark serves as an insulation between the jar's contents and the plug. One other jar stopper was found, with no impressions on the bottom.

Miniature and Unfired Clay Vessels (Fig. 238, 239)

Vessels comprise the largest selection of unfired or miniature objects. The 84 whole or fragmentary specimens are listed in Table 155. All the shapes commonly found among full-size vessels are represented in the miniatures. Bowls are the most common, accounting for 50 percent of the vessels. Jars make up only 15 percent of the vessels. The vast majority of the vessels (73 percent) are unfired.

In many cases, the mode of manufacture is apparent from surface indications. Forty-three percent are crude pinchpots, made by sticking a finger into a ball of clay (Fig. 238: d). Further remodeling of the walls sometimes follows the initial pinch (Fig. 239: c). The coil technique is the next most common method, accounting for 15 percent of the cases. This is the technique used by both modern and ancient Pueblo potters for constructing full-size decorated and utility vessels. The pinchpot technique observed in so many of the unfired miniature pots is often used by modern Indians to start the base (Bunzel 1974: 7). Three potentially full-size vessel fragments were found with the unfinished coiling technique. They may indicate aborted attempts of practicing potters and are probable evidence of local pottery manufacture (Fig. 238: a).

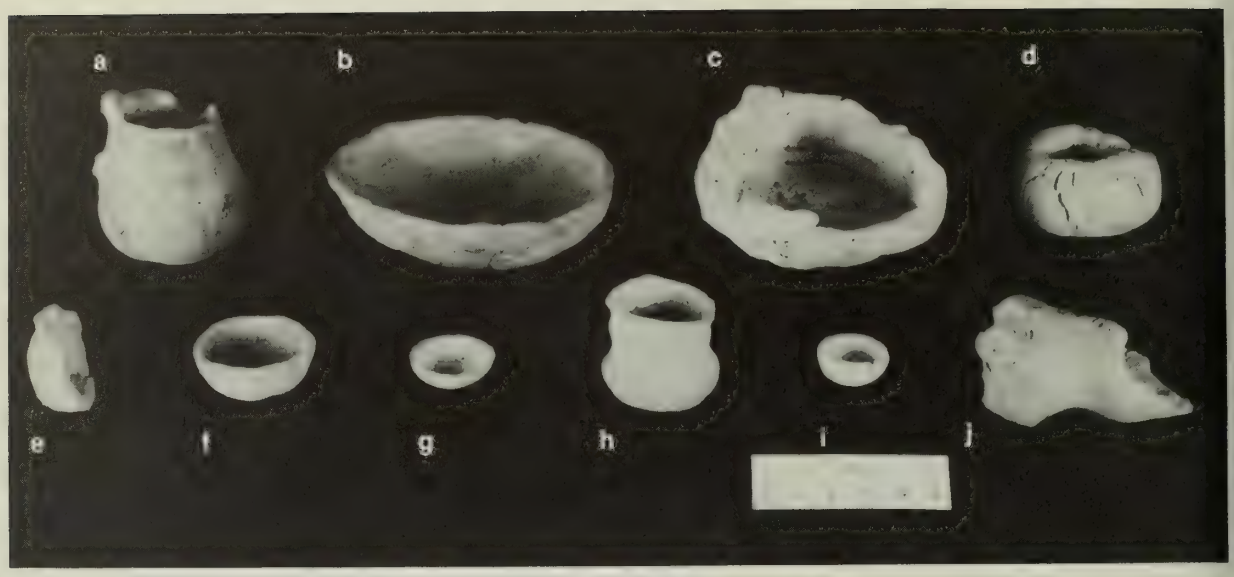


Figure 238. Miniature and unfired clay vessels from Antelope House.

The slab technique is represented in 2 percent of the vessels. Thirty-eight percent are unidentified as to technique of production.

Function of Miniature Vessels

An explanation for the occurrence of miniature and unfired vessels can be based on ethnographic and archeological evidence. One hypothesis is that most miniature and unfired vessels are evidence of pottery manufacturing loci. A second hypothesis is that they relate to ritual behavior or to children's play activities. Just as with the figurines, it is difficult to separate the two functions in archeological interpretation. Conversations between Edmund Nequatewa (1939: 18) and a Hopi potter indicate a ritual significance for fired miniature vessels. The Hopi potter made four miniature vessels and fired them separately for the spirit of a dead person who might cause a bad firing of her own pottery. She placed the vessels at the edge of the village where the spirit could have them, but they also may be placed on the deceased's grave.

An archeological association of fired miniature vessels with pottery production is reported by Brew and Hack (1939: 8–14) near Jeddito Trading Post on Black Mesa. A group of 12 miniature vessels was found nestled in a coal ash heap. Associated reddened and warped sherds and other ash heaps indicated a pottery firing oven. Use of the vessels as toys is suggested by the authors, although ritual use is also possible, given the ethnographic evidence. Miniature vessels are reported from the refuse deposits of many sites, where they usually are designated as toys (Judd 1954: 215; Rohn 1971: 245; Rinaldo 1964: 104).

Groups of associated miniature vessels also were found at Antelope House. Most notable is the group from Room 29, Provenience 1318. A fill layer above Floor 5, dated to Early Pueblo III, contained many unbroken and unfinished objects. This provenience is interpreted as *de facto* refuse from a storage or activity area not directly associated with a hardpack floor. Six unfired miniature vessels were found, differing in shape and crudeness of manufacture (Fig. 239). The largest vessel, a seed jar, had some corn husks stuffed into the small opening, as if to imitate the storage function of a full-sized fired jar. Also associated with this provenience are artifacts suggesting pottery manufacture: a 157-gram slab of raw clay (Fig. 239: d) and three manos. Four other miniature vessels were found in adjacent stratigraphic levels of Room 29, as were some unfired, flat, geometric clay objects, which resemble scrapers (Fig. 240).

These associations of unfired vessels with manufacturing materials may mark pottery production areas. They may be imitations by children of adult behavior associated with production and use of ceramics, constituting a prehistoric case of playing house. It is hypothesized that the clay for the manufacture of miniature vessels

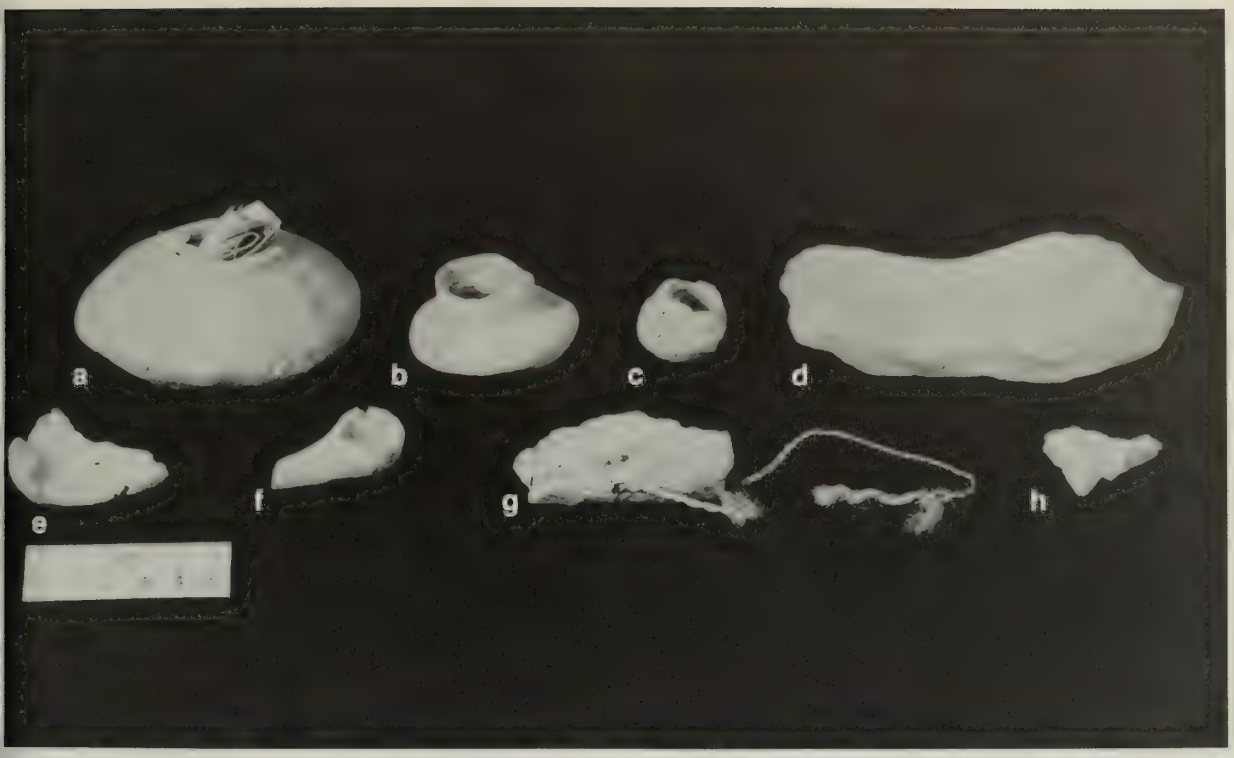


Figure 239. Unfired clay objects from fill above Floor 5, Room 29 (P1318). Items a and h are raw clay slabs; e is composed of two unfired clay coil fragments.

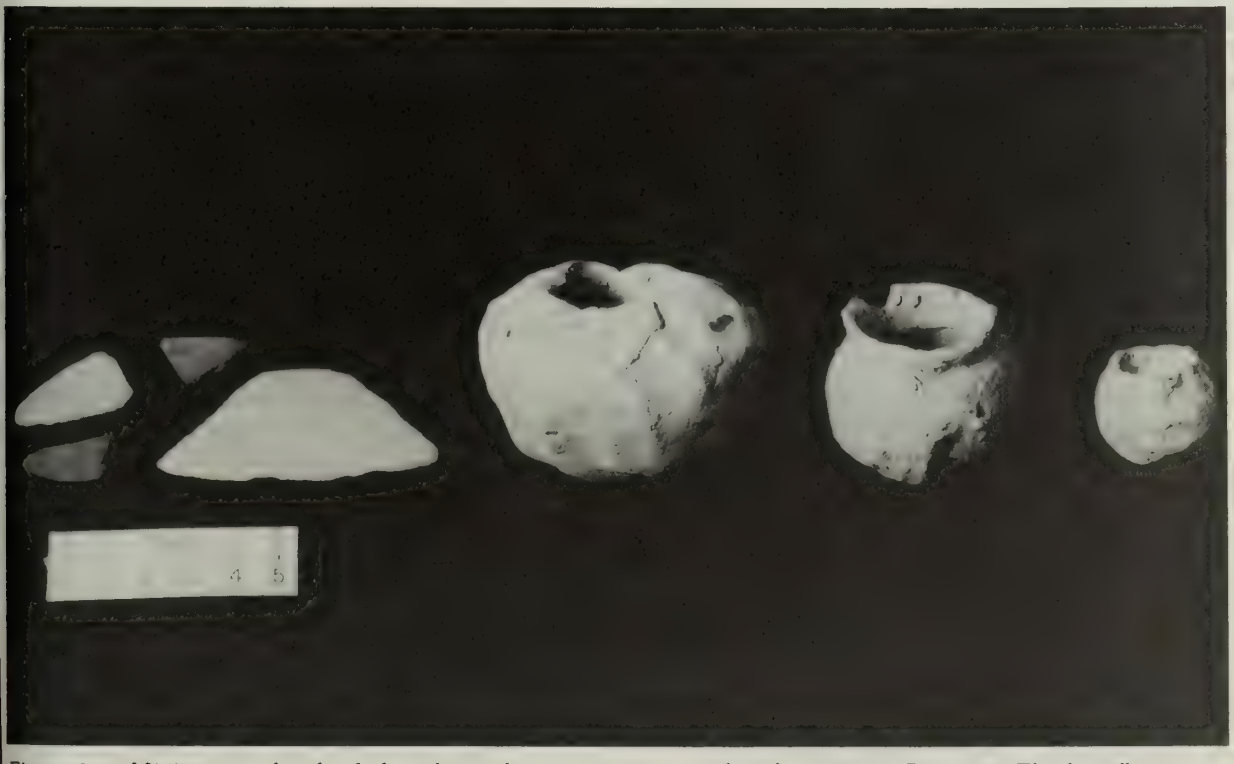


Figure 240. Miniature and unfired clay objects from proveniences other than 1318 in Room 29. The four flat geometric objects of unfire clay at left resemble scrapers.

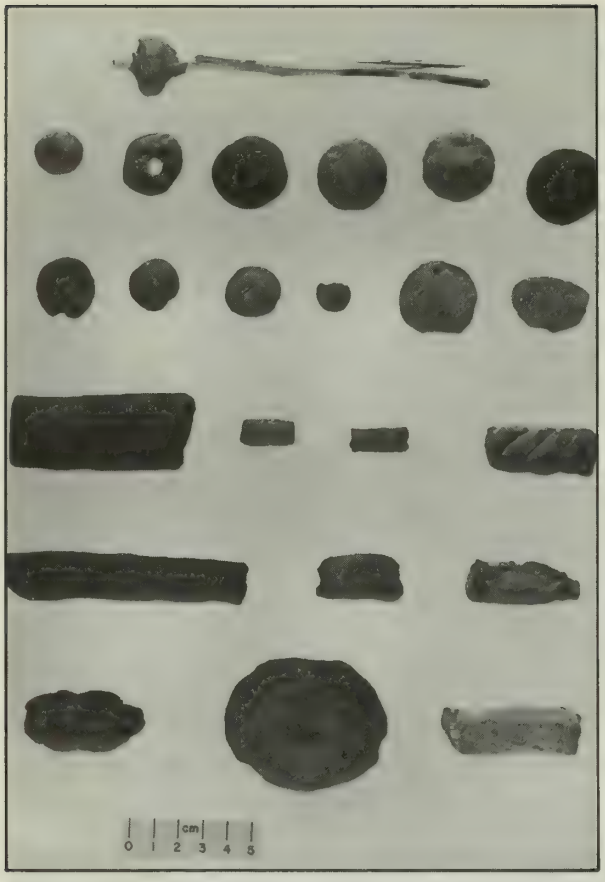


Figure 241. Miscellaneous unidentified unfired clay objects from Antelope House.



Figure 242. Miscellaneous unidentified unfired clay objects from Antelope House.

comes from raw materials brought to Antelope House for regular pottery production. I would, therefore, expect a correlation between raw clay and miniature unfired clay objects at Antelope House. Fired miniature vessels might also correlate with raw clay, although this is less likely, in view of the displacement of the vessels from a kiln area before use. On the other hand, unfired vessels might be more likely to be found where they were made. There is a nonrandom distribution at the site of weights of raw clay measured in grams. However, there is no consistent correlation between proveniences having large amounts of clay and occurrences of miniature vessels. This may well be due to the fact that most miniature vessels are from secondary refuse and not deposited in the same archeological contexts as raw clay.

Some general patterns are discernible, indicating specific ceramic production areas:

1. While only 187 g of raw clay are specifically associated with the unfired assemblage in Room 29, Provenience 1318, there are small amounts associated with many other proveniences stratigraphically above Provenience 1316, totaling for the entire room 4.92 percent of all raw clay. This may indicate that Room 29 was receiving secondary or primary refuse from a pottery manufacturing locus over a period of time.

2. The largest single specimen of clay, which also is the greatest amount for any provenience, was found in the Tower Corridor between the South Room Block and the cliff face (Provenience 264). In the same general area, a large sample of fired and unfired pinchpots also was found, although the pots are widely distributed in stratigraphic proveniences and arbitrary grids in that area (grids marked G–K; Specimens 65–74, Table 155). The Tower Corridor, therefore, may have been a pottery production area.

3. Floor 4 in Room 21 (Provenience 319) yielded many fragmentary fired miniature vessels. Other proveniences in the room yielded

unfired vessels. Very little raw clay was found in the room, however, and none is associated with Floor 4. There also are no temporal or stratigraphic relationships between Room 21 and Provenience 1318 in adjoining Room 29 to indicate a common origin for the activities producing the miniature vessels.

Further research using this type of data might be productive, as indicated by the suggestive, but inconclusive, association found here.

Unidentified Miscellaneous Shapes

Figures 241 and 242 illustrate various shapes of unfired clay objects. Some may be byproducts of pottery manufacture.

Chapter 22

Utility Ceramics

An interest in making maximum use of the information contained in the often neglected artifact category of utility or culinary pottery led to the development of a set of specially designed computer recording forms for the Antelope House analysis. These emphasize detailed observation of stylistic and technical attributes of utility sherds. This method of analysis is directed primarily toward testing behavioral hypotheses about intrasite social groups and pottery discard areas through computer-run statistical tests (see Chapter 24). Sherd analysis also revealed the potential for studying other kinds of ceramic variability. Although not an initial research direction, an exploration into the stylistic differences among utility wares was undertaken (see Chapter 23).

This chapter presents an explanation of the general research procedures for the utility pottery study, including sampling, and a description of the major changes in these ceramics through time. Final sections of the chapter describe the whole vessel and recycled utility sherd data.

Research Procedures

At the time the Antelope House utility ceramic analysis began, only a few studies that nonmetrically identified and described different styles of corrugated wares were available (Reed 1958; Martin 1938; Hayes 1964). I wanted to do a detailed analysis of sherds, emphasizing attributes relevant to specific problems. A form was developed for coding observations and measurements on both metric and nonmetric variables of sherds. Such attributes as temper, direction of coiling, coil width and depth of indentation were recorded. My analysis depends heavily on Shepard (1936), a study unique in its emphasis on detailed examination of the nonmetric and metric attributes of utility sherds. A recently published manual (Bennett 1974), however, also presents a method of detailed analysis based on attributes similar to those used in my study.

The computer forms, code sheet and an explanation of the codes and recording procedure may be found in Appendix J. Two categories on the form, which concern the number of sherds used in analyses, should be explained here: (1) "Surfal" refers to surface treatment and distinguishes plainwares from corrugated wares. The latter are used in most of the analyses here, since plainware sherds do not exhibit attributes related to coil manipulations. (2) The "mended-related" entry indicates whether the data on the form refers to one or a number of sherds from the same vessel. If two or more sherds are determined to be from the same vessel, that number is recorded. By multiplying the data on the form by this number, the absolute frequency of sherds analyzed is obtained. These are referred to as weighted data. Frequencies for proveniences derive from these data. In some cases (see Chapter 24), however, I wished only to represent the variety of vessels present, hence the variety of manufacturing techniques, without stressing situations in which some vessels were represented

Table 156. Utility pottery ware categories.

Ware	*Name*	*Main temper ingredient*
TGW	Tusayan Gray Ware	sand
MVG	Mesa Verde Gray Ware	rock-igneous
XGW	Brand X Gray Ware	sherd
CGW	Chuska Gray Ware	rock-trachyte
LCG	Little Colorado Gray Ware	sand and/or sherd
MBW	Mogollon Brown Ware	sand/mica/sherd

by high sherd counts and others by very low counts. For these studies, a computer form is counted only once even if it records data for a number of sherds from the same vessel. These are referred to as unweighted data. Unfortunately, the problem of how many sherds represent one unbroken vessel (which was handled to some extent in Rohn 1971) could not be eliminated in the present study.

General description of utility sherds is provided by ware and type identification. Ware categories borrow the terms used in Colton's *Pottery Types of the Southwest* (1955) as convenience labels, without necessarily implying his specific associated descriptions and meanings. The main criteria used to classify a sherd into a ware category is temper, as shown in Table 156.

According to Colton, the dominant utility ware associated with the Kayenta branch of the Anasazi in northern Arizona from BMIII to Late PIII is Tusayan Gray Ware. Tusayan Gray Ware (TGW) here designates sherds with sand temper or with sand combined with lesser amounts of other types of temper. This is the most prominent utility ware at Antelope House; it is found in higher percentages than any other ware throughout the occupation of the site, except in Late PIII. During this period, a high proportion of sherd-tempered utility pottery appears at the site. Brand X Gray Ware (XGW) is my designation for ceramics with sherd temper or with sherd combined with lesser amounts of sand or other material. This ware is not obviously related to any established Anasazi ware tradition and its label emphasizes its undefined status.

Mesa Verde Gray Ware (MVG) is another prevalent utility ware in the Four Corners Region during BMIII and Pueblo periods. This is a crushed rock-tempered ware very similar to TGW in style, surface treatment and shape of vessels (Colton 1955). Although it is the major utility ware in the Mesa Verde region just northeast of Canyon de Chelly, only five MVG utility sherds were recovered from Antelope House. The presence of XGW with a corresponding absence of MVG in Late PIII is discussed in Chapter 23.

Two wares occur in fairly minor quantities in the Antelope House utility assemblage. Little Colorado Gray Ware (LCG), distinguished from other sand-tempered wares by a paste with high iron content, accounts for less than 4 percent of the total utility sherds. Chuska Gray Ware (CGW) is a trachyte or sanidine basalt-tempered pottery and has been the focus of attention of surveys in the Chuska Valley and the lower Chaco River (Windes 1977; Harris *et al.* 1967; Peckham and Wilson n.d.). Comparison of this fairly scarce ware with TGW is presented in the following chapter. Only two utility sherds of Mogollon Brown Ware were found at Antelope House.

Type is a descriptive label that differentiates sherds within wares on the basis of surface appearance. Again, Colton's (1955) type names are used and our types generally represent his descriptions of surface finish. However, they are not ware specific. For example, Kana'a records a type of sherd with flattened, unindented coils, regardless of temper or ware. These types are primarily time related, with Tusayan corrugated the most common type for all Pueblo utility wares at Antelope House.

The subtype category allows description of the varieties of coil manipulation that make up the types. Subtypes include obliterated, indented, tooled and finger-grooved. Most of the other attributes recorded on the computer forms are self-explanatory.

Data from whole or restored vessels also are used in the following analysis, but in a limited way, since the number of whole Anasazi vessels is low (61 for the site as a whole). Attributes recorded for sherds, plus shape and size, were recorded for whole vessels but were not computerized.

Sampling

Because of the large number of utility sherds recovered during the excavation of Antelope House, the interpretations of human behavior based on utility ceramics are derived from analysis of a sample. A brief description of this sample follows. An indication of the representativeness of the sample for the site as a whole is given by percentage distributions of sherds through time and space.

About 13 percent of all utility sherds recovered (9717 of 72,657) were analyzed. Utility sherds were classified into two categories: (1) corrugated, the traditional Pueblo culinary ware, which includes such styles of coil manipulation as banded, indented, incised and finger-grooved, and (2) plain rough, defined as scraped or obliterated sherds with no evidence of paint or polish. The sample consists of 7464 corrugated sherds and 2253 plain rough sherds. Analyses focus on the corrugated wares, which provide more information on variability than do plainwares.

The utility pottery sample used in the following analyses is taken from all 182 critical dated proveniences containing undecorated sherds. Critical proveniences are features in floors, such as hearths or cists, or arbitrarily designated 5-cm floor contact layers. The latter may contain *de facto* or primary refuse (see Chapter 21), but they are most commonly secondary refuse deposits at Antelope House. All other proveniences are referred to as non-critical. The fact that critical provenience data do not constitute a probabilistic sample must be kept in mind in evaluating our conclusions.

Spatial Analysis of Sampling

The total number of utility sherds and vessels recovered and the number sampled in analysis vary by room block. Some description of this variability is useful, since the utility pottery analysis dealing with social groups uses these spatial categories.

The South Room Block yielded the greatest number of utility sherds and almost 66 percent of all sampled sherds. The rest of the sample is more evenly divided between the North and Central Room Blocks.

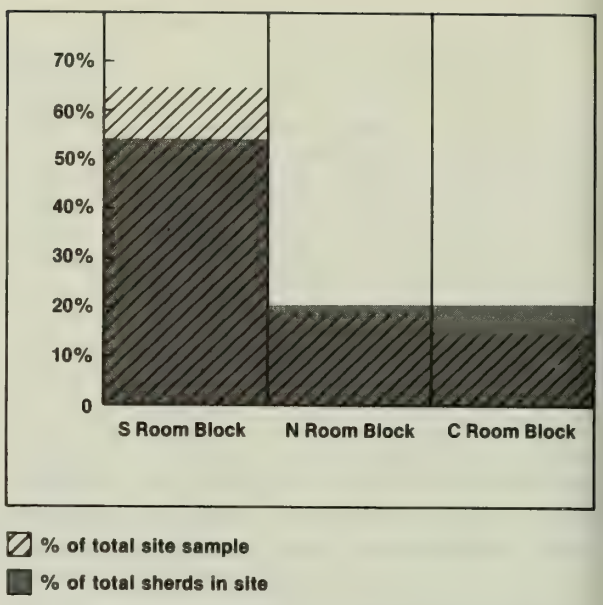


Figure 243. Percentages of total sherds per room block and of sampled sherds per room block used in utility ceramics analysis.

Two conditions should be met if the sample is to be distributed representatively. First, about equal percentages of the sherds from each room block should be sampled. Second, the percentage of total sherds per room block and the percentage of sampled sherds per room block should be equivalent. Neither condition is satisfactorily met in a nontemporal room block analysis of the utility pottery sample (see Table 157 and Fig. 243).

The percentage of sherds sampled per room block varies from about 16 percent to 10 percent, the lowest being from the Central Room Block. The second comparison of percentages shows oversampling in the South Room Block and undersampling in the North and Central Room Blocks. The South Room Block generally contains more sherds from critical proveniences, especially in nonroom areas. Nonroom areas are those areas not within structures and that were excavated by grid proveniences: the South Plaza, the Tower Corridor, the Central Plaza, the Central Plaza Annex and the North Trash. Floors in the South Plaza were used extensively in the sample, while no North Trash deposits were. The undersampling in the Central Room Block appears to derive from undersampling of both room and nonroom proveniences.

Table 157. Spatial analysis of sampling of utility pottery.

	South Room Block		*North Room Block*		*Central Room Block*	
	All Proveniences	*Non-room Proveniences*	*All Proveniences*	*Non-room Proveniences*	*All Proveniences*	*Non-room Proveniences*
# of sampled proveniences	76		40		40	
# of total sherds	40,722	18,481	15,056	6460	14,942	6663
# of sampled sherds	6387	2156	1841	0	1489	591
% of site total	56.1	25.4	20.7	8.9	20.6	9.2
% of sample total	65.7	22.2	19.0	0.0	15.3	6.9
% difference of above two lines	+14.6		−1.5		+25.7	
% sampled in room block	15.7	11.7	12.0	0.0	10.0	8.9

Table 158. Spatial distribution of utility sherds in Late Pueblo III (weighted room data).

	South Room Block	*North Room Block*	*Central Room Block*
# of total sherds	5727	5387	3451
# of sampled sherds	1293	1177	870
% of site total	39.3	37.0	23.7
% of site sample	38.7	35.2	26.0
% sampled in room block	22.6	21.8	25.2

Table 159. Temporal distribution of utility sherds (* indicates over- and under-sampling).

	BMIII	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*Site as a Whole*
# of sampled dated sherds	50	1174	883	1287	549	3741	7684
# of total dated sherds	455	4470	6715	6181	9668	33,032	60,521
% of site's total dated sherds	.75	7.39	11.10	10.21	15.97	54.59	
% of site's sampled dated sherds	.65	15.28	11.49	16.75	7.14	48.69	
% difference of above two lines*	−13.3	+51.6	+3.4	+39.0	−55.3	+9.0	
% sampled of period's total dated sherds	11.0	26.3	13.2	20.8	5.7	11.3	

The analysis of variability in utility sherds by room block (Chapter 24) is restricted to Late PIII. Similar percentage comparisons for this period argue for greater confidence in the sampling strategy. Both conditions mentioned above are fairly well satisfied (Table 158).

Temporal Analysis of Sampling

Not all proveniences resulting from excavation could be given a temporal assignment. The majority, however, either were absolutely dated or were placed in the traditional Anasazi periods by architectural or decorated ceramic data. The utility pottery sample is taken from provenience dated BMIII, PI, PII, Early PIII, Middle PIII and Late PIII. Some proveniences could be given only a general PIII date; 35 utility sherds come from such proveniences. It is recognized that these period classifications are not the ideal temporal data for behavioral analyses, but they must be used in the absence of complete absolute dating for the site. In this chapter, these periods are used to give an indication of the temporal changes in sampling and in the utility ceramic assemblage itself.

About 83 percent of all utility sherds and 79 percent of sampled sherds are dated. The distribution through time of the dated sherds is presented in Table 159. Of all dated utility sherds,

Table 160. Temporal distribution of utility wares (counts of corrugated and plainware sherds; weighted data).

Ware*	Indeterminate	BMIII	PI	PII	EPIII	MPIII	LPIII	General PIII	Total
TGW	1143	45	890	722	1050	470	1837	25	6182
XGW	727		21	20	61	35	1640	5	2509
CGW	96		260	116	82	31	102	3	690
LCG	32	5	3	19	94	13	157	2	335
IND/MVG/MBW									11
Total									9717

*See Appendix J for ware descriptions.

Table 161. Temporal distribution of utility wares (percentages of corrugated and plainware sherds; weighted data).

Percent of sherds of a given ware per period Ware	BMIII	PI	PII	EPIII	MPIII	LPIII
TGW	.9	17.7	14.3	20.8	9.3	36.4
XGW		1.2	1.1	3.4	2.0	92.3
CGW		44.0	19.6	13.9	5.2	17.3
LCG	1.7	1.0	6.1	32.3	4.0	54.0

Percent of sherds of a given period per ware Ware	BMIII	PI	PII	EPIII	MPIII	LPIII
TGW	90.0	75.8	82.3	81.7	85.6	49.2
XGW		1.8	2.3	4.7	6.4	43.9
CGW		22.1	13.2	6.4	5.6	2.7
LCG	10.0	.3	2.2	7.3	2.4	4.2

12.7 percent (7684 sherds) were sampled. For individual periods, this percentage varies from 5.7 to 26.3. Further, the difference between the percentage of total dated sherds in each period indicates some over- and under-sampling. This sampling factor may affect the temporal changes in distribution of ware, type, subtype and other attributes. For the analyses presented in Chapters 23 and 24, however, these variations in sampling are not significant, since each study is limited to one period, either PII or Late PIII. As Table 159 shows, these are the periods with the least discrepancy between percentage of total sherds and percentage of sampled sherds.

Description of Changes in Utility Pottery through Time

Study of ware, type, and of metric and nonmetric attributes related to the surface appearance of sherds reveals temporal changes in the utility pottery assemblage at Antelope House. The following description consists of observations of the percentage changes in these attributes through Pueblo periods. Basketmaker III sherds are not included; these number only 50 and are entirely Little Colorado Gray and Tusayan Gray plainwares. Appendix J provides definitions of the attributes discussed here.

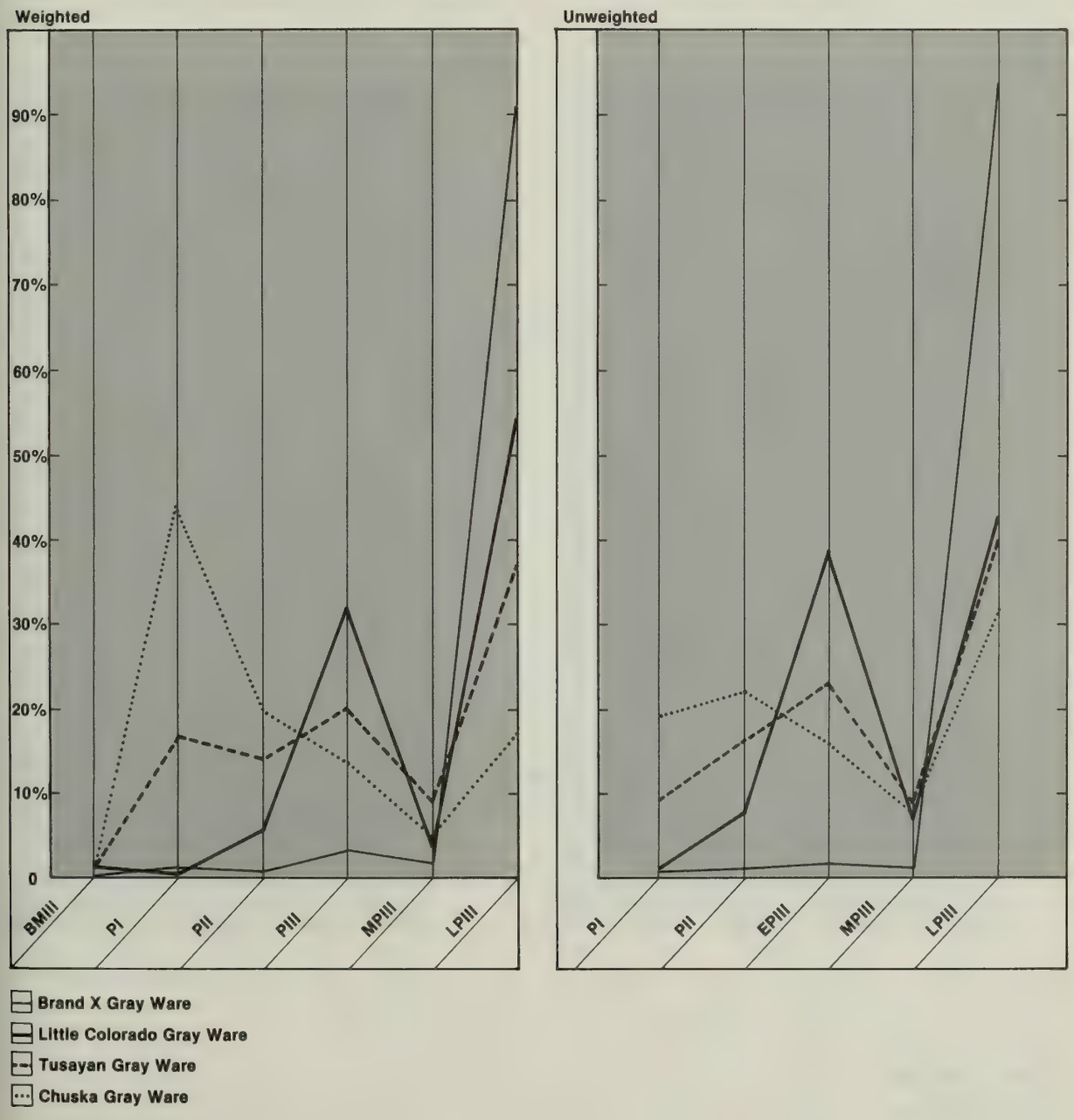
Ware

Four major utility wares were recovered from Antelope House (Tables 160, 161; Fig. 244, 245). Considering these, Little Colorado Gray Ware makes up the smallest percentage of dated utility sherds (3.8 percent). It constitutes more than 7 percent of the sherds in Early PIII and a smaller proportion in all other periods. Chuska Gray Ware accounts for 7.7 percent of dated utility sherds. More than half of the sherds of this ware were recovered from PI and PII proveniences; its percentage of the total assemblage steadily declines from a high of 22 percent in PI to a low of 2.7 percent in Late PIII.

Tusayan Gray Ware is uniformly the most common utility ware at Antelope House, accounting for almost 66 percent of dated sherds. From PI to Middle PIII, TGW makes up 75 to 85 percent of the sherds, but its proportion drops to 49 percent in Late PIII, a time of sudden increase in Brand X Gray Ware sherds. The latter accounts for 23 percent of all utility sherds. XGW does not exceed 7 percent of the sherds in a given period until Late PIII, when its percentage is nearly equal to that of TGW. Although among decorated ceramics Mesa Verde White Ware dramatically increases and Tusayan White Ware decreases in Late PIII at Antelope House, no assemblage of Mesa Verde utility sherds was found.

The decline in Chuska Gray Ware after PI and PII and the increase in Brand X Gray Ware sherds to nearly half the assemblage in Late PIII

Figure 244. Temporal distribution of utility wares from Antelope House; percentage of sherds of a given ware per period (weighted, right, and unweighted data).

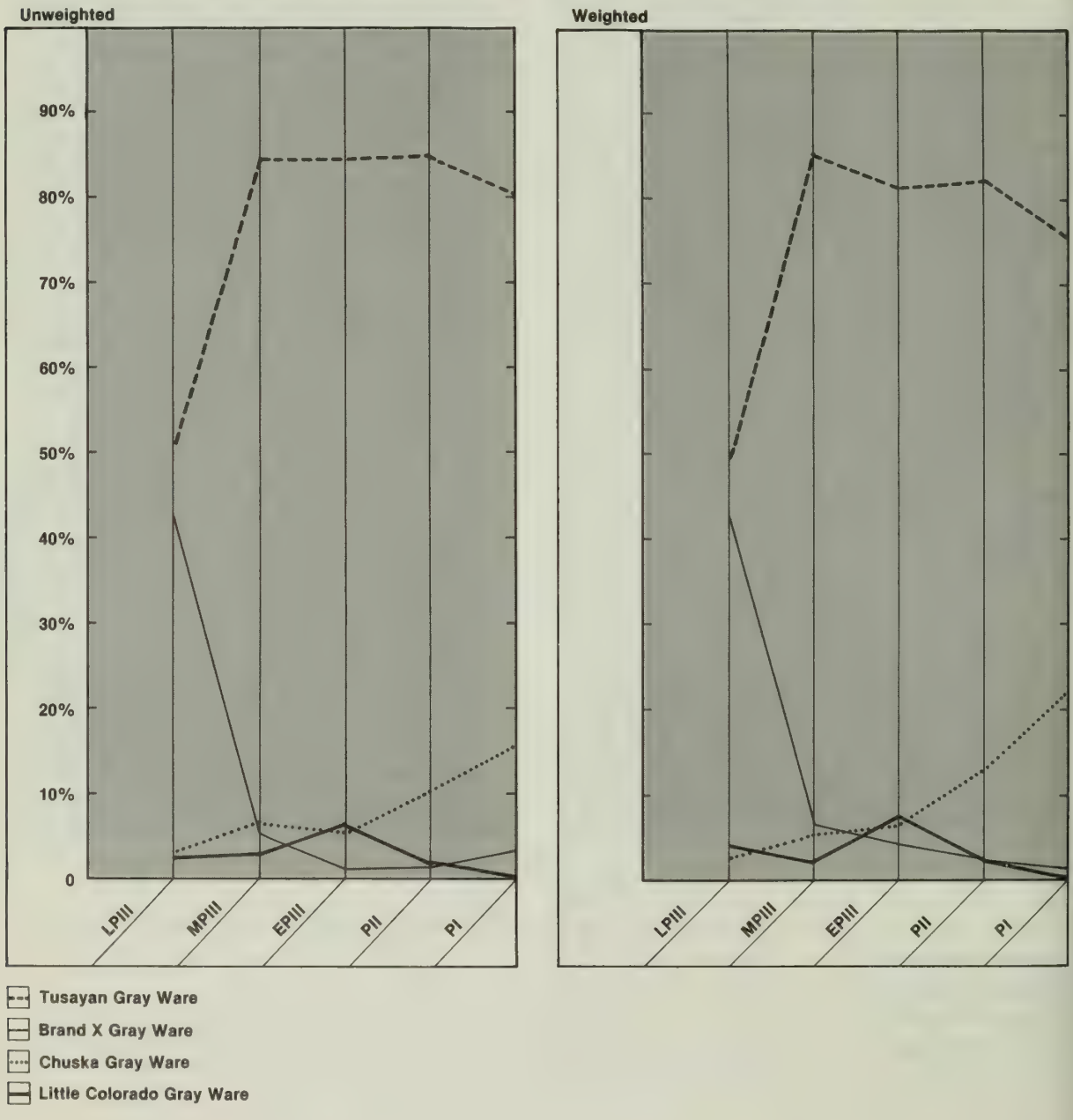


are the major temporal changes revealed by utility ware analysis. The implications of these trends are discussed in Chapter 23.

Type

Changes through time in the type category for Antelope House utility pottery correspond to the general sequence found in Anasazi ceramics: a change from unobliterated neck coils to complete corrugation of a vessel (Table 162; see also Colton 1955, Kidder 1936, and Appendix J). The Kana'a type, or neck-banded style, is prevalent in PI and PII, after which it declines. The proportion of the Tusayan corrugated type, or plain indented in Hayes' (1964) terminology, begins to increase in PII, reaches a maximum of 60 percent in Middle PIII, and declines slightly in Late PIII. At this time, the indented blind corrugated type, in which coils are obliterated but indentations are only partially obliterated or unobliterated,

Figure 245. Temporal distribution of utility wares from Antelope House; percentage of sherds from each Pueblo period per ware (weighted, left, and unweighted data).



begins to increase. The exuberant corrugated type is most common in PI and PII and the Moenkopi type in Early and Middle PIII.

Subtype

Classification of utility wares on the basis of surface appearance has been undertaken by a number of archeologists (see Martin 1935, Shepard 1939, Reed 1958 and Hayes 1964). These classes consist of descriptions of varieties of coiling and indenting techniques and the "styles" that result. The list of subtypes used in this analysis derives from these earlier studies, and their distribution in the Antelope House assemblage shows similar changes through time. Table 163 presents the composition of periods by groups of similar subtypes.

PI has the highest percentage of subtypes characterizing the Kana'a style, but an unusually low percentage of obliterated or plain sherds. This may be the result of the small sample from this period. A different distribution prevails from PII through PIII, consisting of high percentages of obliterated and indented sherds. Early PIII shows the greatest proportion of incised and finger-grooved variations. Increases in the subtype of indented with unindented coils and in the indented blind subtype of indented with unindented coils and in the indented blind subtype are indicated for Late PIII.

The style of indentation of utility sherds has been further categorized into descriptive types, such as flat wavy, sawtooth, square (Martin 1938: 268) or flattened, exuberant and wedgepoint (Reed 1958: 119). For this analysis, surface appearance is described nonmetrically by the attributes of overall surface design and direction of coiling, and metrically by measurement of coil width, distance between indentations, and depth of indentation.

Table 162. Temporal distribution of utility pottery types; percent of sherds in a given period per type*.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
Indented Blind Corrugated†	9.0	17.3	17.8	9.0	24.4	
Kana'a	62.8	29.7	6.0	4.1	2.2	
Moenkopi	6.4	9.5	22.8	22.8	14.9	
Exuberant Corrugated	5.1	4.4	1.7	.9	1.1	
Tusayan Corrugated	16.7	38.7	47.6	60.1	52.7	
Kiet Siel	0	.2	3.0	2.8	4.3	
Other	0	.2	1.1	.4	.4	
						Grand Total
Total number of sherds	78	863	1059	469	3238	5707

*Weighted data, corrugated sherds only, excluding indeterminate and general PIII dates.
†Referred to as Indeterminate type, see Appendix J.

Table 163. Temporal distribution of utility pottery subtypes (see Appendix J); percent of the sherds in a given period per subtype.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
Obliterated	3.8	72.2	37.3	52.0	29.7	
Partially obliterated	4.5	5.8	14.6	9.7	14.4	
Flattened, overlapping or nonoverlapping coils	65.4	3.1	2.7	2.0	2.7	
Indented with bands of unindented coils	1.9	.9	2.5	.9	4.8	
Indented	22.4	15.9	32.9	30.3	35.1	
Incised or finger-grooved	1.9	1.8	5.7	2.7	1.8	
Indented blind	0	.3	4.2	2.3	11.4	
						Total
Number of sherds observed	156	1166	1136	442	2903	5909

Table 164. Temporal distribution of overall surface design styles; percent of the sherds in a given period by design style category, excluding indeterminate category.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
Right	9.0	24.9	23.1	6.9	13.1	
Left	52.5	2.9	4.0	6.7	3.1	
Alternate	2.3	14.9	7.9	4.5	5.5	
Combination	6.8	56.0	62.9	41.3	73.6	
Overlap	34.1	1.2	2.0	.6	4.6	
						Total
Number of sherds observed	88	241	445	179	1128	2081

Table 165. Temporal distribution of direction of coiling; percent of the sherds in a given period per coiling directions.

	PI	*PIII*	*EPIII*	*MPIII*	*LPIII*	
Right	32.6	96.9	96.9	95.7	97.4	
Left	67.4	3.1	3.1	4.3	2.6	
						Total
Number of sherds observed	138	325	655	210	1758	3086

Number of cases of indeterminate direction of coiling = 5408

Overall surface design

This indicates the manner in which indentations are aligned between coils. Percentages of this attribute are shown for the styles of right, left, alternate, overlap and combination in Table 164. All periods, except PI, have "combination" as the most frequent design style. Disregarding these sherds, the dominant styles for PII and Early to Late PIII are right and alternate. PII, in fact, has the highest percentage of alternate design. This distribution represents a shift from the PI period, which contains many lefts and overlaps but few rights and alternates. The traditional view of experimentation in styles of indentation early in the Pueblo sequence, with a certain amount of standardization in later times, is given some support by the Antelope House utility pottery data.

Direction of coiling

This is determined for most sherds by the angle of the indentations. Coiling direction is opposite to that of the abrupt side of the indentation (see Appendix J). Very little variability is evident through time, except in PI (Table 165). Pueblo I shows about 67 percent left coiling and 33 percent right coiling; all other periods show more than 95 percent right coiling. This difference may result from the high percentage in PI of CGW sherds, which exhibit a substantial amount of left coiling.

Metric measurements provide objective descriptions of the changes in surface appearance of utility sherds through time. Derivation of these attribute categories depended heavily on Shepard's (1939) analysis of La Plata pottery. Traits such as coil width have been measured by other researchers, but aside from a recent manual (Bennett 1974), the La Plata study alone provides complete and detailed objective, as well as subjective, analysis of utility ceramics. Shepard (1939: 278) states that "variation in appearance is produced principally by differences in width and relative flatness of coil, and in depth, slope, and regularity and spacing of indentations." Coil width, distance between indentations and depth of indentation were measured in the Antelope House analysis.

Table 166. Temporal distribution of coil width; percent of the sherds in a given period by category of coil width.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
1–3 mm	.3	.2	.1	.8	.5	
4 mm	.3	4.2	6.6	7.4	10.3	
5 mm	12.6	18.5	21.4	20.3	38.2	
6 mm	7.0	34.1	33.2	30.9	26.6	
7 mm	17.7	21.1	17.8	26.2	15.1	
8 mm	9.7	10.8	12.9	8.2	5.4	
9 mm	4.0	3.1	2.2	3.1	2.1	
10 mm	21.2	2.6	3.0	1.6	.7	
>10 mm	27.3	5.5	2.8	1.6	1.1	
Number of sherds measured:	373	455	828	256	2088	Total 4000

Table 167. Temporal distribution of distance between indentations; percent of the sherds in a given period by category of distance between indentations.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
3– 4 mm	0	0	.2	1.5	4.4	
5– 6 mm	3.2	14.8	13.7	26.3	19.8	
7– 8 mm	23.4	49.3	32.1	42.8	44.8	
9–10 mm	17.0	28.5	39.7	15.4	22.7	
11–12 mm	1.1	6.0	10.1	6.7	6.3	
13–14 mm	25.5	.7	3.5	4.2	1.3	
>14 mm	29.8	.7	.7	3.1	.7	
Number of sherds measured:	94	298	575	194	1596	Total 2757

Mean distance between indentations for PIII

Time	*Distance (mm)*
EPIII	8.68
MPIII	8.04
LPIII	7.83

Coil width (Table 166)

In this, as in the attributes discussed above, PI shows unusual characteristics. The distribution for PI has high percentages of coil widths of 5 mm, 7 mm and more than 10 mm. PI is the only period with a high percentage of wide coil widths. Extremely wide coils are found on sherds typed as exuberant corrugated; this type is most common at Antelope House in PI. Pueblo II through Late PIII generally have highest frequencies between 5 mm and 7 mm, with the Late PIII distribution somewhat skewed toward narrower coils. These data compare well with other analyses, which show a decrease in width of coils from PI to PIII (Brew 1945; Judd 1954: 188; Hayes 1964: 52).

Distance between indentations (Table 167)

PI again has a distinct pattern of distribution of measurements, showing a bimodal curve with peaks at 7 mm to 8 mm and at 13 mm to 25 mm. In no other period is distance between indentations so great, indicating a correspondence between this attribute and coil width. Room 1 proveniences dated PI have a number of sherds with "thumb-impressed" indentations, resulting in overlap design and in a large distance between indentations.

Distances between indentations from PII through Late PIII most commonly fall between 5 mm and 10 mm; PII, Middle PIII and Late PIII have the highest percentages at 7 mm to 8 mm, Early PIII the highest at 9 mm to 10 mm. The

Table 168. Temporal distribution of depth of indentation; Percent of sherds in a given period by category of depth of indentation.

	PI	*PII*	*EPIII*	*MPIII*	*LPIII*	
.01 through .99	0	6.0	9.1	3.6	7.2	
1.00 through 1.49	10.5	39.5	61.2	64.0	66.1	
1.50 through 1.99	11.4	38.9	20.0	29.2	23.0	
2.00 through 2.49	31.6	8.3	7.5	3.2	2.6	
>2.49	46.5	7.3	2.2	0	1.1	
Number of sherds measured:	114	301	580	192	1561	Total 2748

Table 169. Temporal distribution of whole, partial and restored utility vessels.

	BMIII	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*General PIII*	*Total PIII*	*Indeterminate*
# of vessels	8	1	14	10	7	11	2	30	8
% of dated vessels	13.1	1.6	23.0	16.4	11.5	18.0	3.3	56.6	—
TGW	8	1	13	8	4	8	2	22	6
CGW			1	2	1			3	1
XGW					2	3		5	1

mean distance between indentations for PIII periods also indicates a trend toward decrease in this measure through time.

Depth of indentations (Table 168)

Indentations of utility sherds in the Antelope House assemblage generally become shallower through time. PI has the deepest indentations, with about 78 percent measuring 2 mm or more in depth. The PIII sherds exhibit high percentages of depths of 1 to 1.5 mm.

Summary of Change through Time

For most of the metrically measured attributes of style, a continuing directional change through time is evident. Sherds from PI (and, to a much lesser extent, from PII) show obvious differences from PIII sherds in most of the attributes analyzed. Shepard's (1939: 279) observation that PIII sherds at La Plata exhibit shallower, more closely spaced indentations than do earlier sherds describes the general trend at Antelope House. A certain amount of standardization and a temporal trend toward narrower coils and "finer" indentation styles are discernible in the utility pottery.

Referring to the Ackmen-Lowry area, Paul Martin (1938: 768) states:

> This minute subdivision (of surface appearance of utility ceramics) was purposely undertaken to see whether significant cultural or chronological data could be extracted from such manipulations. However, no data were obtained, and this subdividing served only to bring out the great diversity in types.

Analysis of Antelope House data shows that some chronological significance may indeed be attached to stylistic and technical attributes of utility ceramics. A widespread investigation of the changes in surface treatment of utility wares is needed to set more precisely the range of variation for different periods. Nontemporal factors operating to produce different "styles" of unpainted ceramics are explored in Chapter 23.

Whole, Partial and Restored Utility Vessels

The number of whole, partial or restored utility vessels from the Antelope House excavation is surprisingly small, consisting of only 61 Anasazi vessels and three Navajo vessels. The small number of cases precludes behavioral investigations with statistical testing, but chronological changes in attributes of whole vessels, such as coil width and depth of indentation, can be compared with analogous sherd data. Much of this information is presented in tables and figures; brief summaries follow.

Most of the whole vessels are from Pueblo periods; 44 date to PII and PIII (Table 169). Eight vessels date to BMIII; these are from Structures

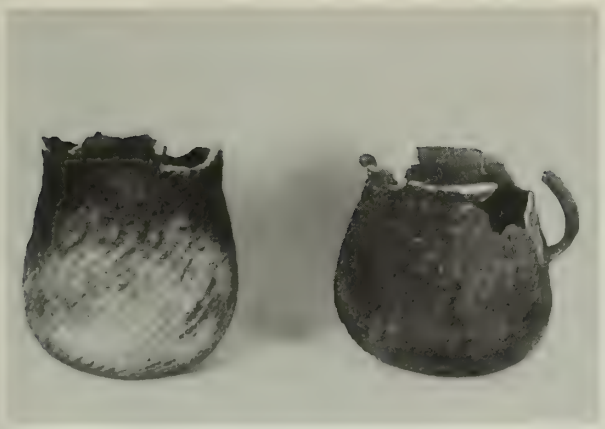


Figure 246. Utility vessels from a slab-lined pit in Room 18; FS 1512 (left) and FS 1311 (see Table 170).

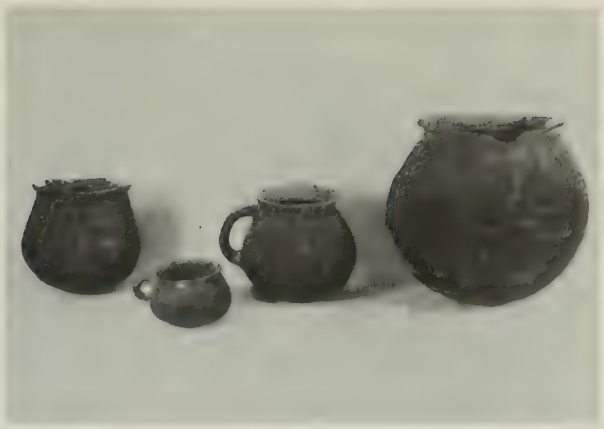


Figure 247. Utility vessles from Burial 11, Room 29; (from left) FS 1872, FS 1883, FS 1890 and FS 1870 (see Table 170).

59, 67 and 71 in the east-central area of the site. Three Navajo vessels were found in upper excavation levels. With one exception, PII, Early PIII and Middle PIII vessels are concentrated in the South Room Block and South Plaza area. Late PIII vessels are more evenly distributed throughout the site. Most of the Middle PIII vessels come from Burial 11 in Room 29. This room, Room 21 and the South Plaza together yielded almost 56 percent of the whole vessels recovered. It is doubtful whether this sample constitutes an accurate representation of the prehistoric distribution of pottery at Antelope House.

Many of the whole Anasazi vessels are from caches in floors, particularly in the South Plaza. These pots often are upright and associated with slab lids. Also found was a *de facto* refuse deposit of utility and decorated pots in a slab-lined pit in Room 18 (Fig. 246; see Chapter 21). Twelve ceramic items were found in Burial 11, Room 29, including four utility vessels: a mug, a small pitcher, a small jar and a large jar (Fig. 247). These utility vessels, together with the decorated ladles, jars and bowls, may represent the assemblage of pottery associated with this person during his lifetime. *De facto* and primary refuse proveniences of whole vessels are summarized in Table 170.

Changes through time evident in whole vessels are similar to those shown by the sherd data. The whole vessels are predominantly Tusayan Gray Wares, with a few examples of Chuska Gray in Early PIII and Middle PIII and of Brand X Gray in Middle PIII and Late PIII (Table 169). BMIII vessels are all Tusayan Gray Ware of the Lino type and are mostly of the "seed jar" shape (Fig. 255).

Table 171 shows how metric attributes of style and technique generally decrease in size from PII to Late PIII in the sample of whole vessels. On the other hand, vessel size varies considerably, with Early PIII having the greatest average maximum diameter, maximum height and volume, and Middle PIII the smallest (Table 172). The average volume of Late PIII vessels is about half that of PII vessels.

Both average rim diameter and amount of rim obliteration decrease between PII and Late PIII (Table 173). For the most part, Middle PIII and Late PIII vessels have more everted rims than do earlier vessels (compare Fig. 256 with Fig. 253). A list of the subtypes found among whole vessels, along with complete descriptive data, is given in Table 174. PII vessels primarily are indented overall or have diagonal finger grooving at the base of the pot, with indented coils elsewhere. Some Early PIII pots have unindented coils combined with obliterated or indented coils and/or incising between coils (Fig. 253). Four of the 11 Late PIII pots, both XGW and TGW, combine unindented with indented coils.

Functions of different utility vessels could not be rigorously tested, but some observations on attributes presumed to be associated with use are presented here. Further discussion of functional variability may be found in Chapter 23.

More than 50 percent of the whole vessels have volumes between 4 and 14 liters (Table 175). About 18 percent have larger volumes (20 to 24



Figure 248. Utility vessels from Room 21; (from left) FS 802, FS 800 and FS 801 (see Table 170).



Figure 249. Utility vessels from Antelope House; FS 531 (left) and FS 732 (see Table 170).

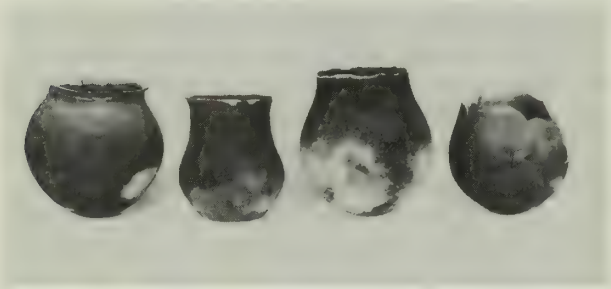


Figure 250. Pueblo II and Early PIII restored utility vessels from Antelope House; (from left) FS 549, FS 566, FS 1360 and FS 1361 (see Table 170).

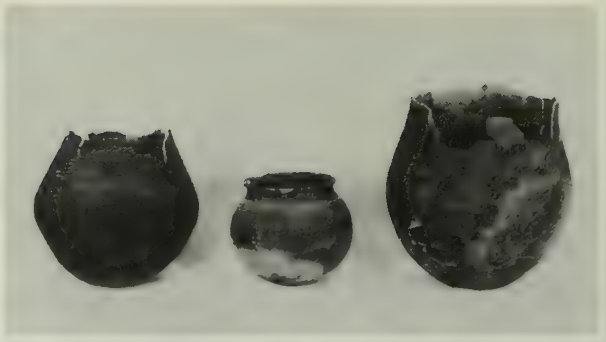


Figure 251. Utility vessels from the South Plaza; (from left) FS 573, FS 1631 and FS 129 (see Table 170).



Figure 252. Early PIII Chuska Gray Ware utility vessel from the South Plaza (see Table 170).



Figure 253. Early PIII utility vessels from the South Plaza; (from left) FS 1460, FS 1461 and FS 1462 (see Table 170).

Figure 254. Early PIII utility vessels from Room 29; FS 2041 (left and FS 2042 (see Table 170).



Table 170. Contexts of recovery of whole, partial and restored utility vessels.

Provenience	*Date*	*Description*	*Field Specimen*	*Ware and type*		*Photo*
Room 18 (1144)	LPIII	Slab-lined pit, part	FS 1511	TGW	Tusayan	Fig. 246
Feature 2		of floor 1	FS 1512	TGW	Tusayan	Fig. 24
Room 21 (369, 370)	PII	Special activity	FS 800	TGW	Tusayan	Fig. 246
		area, on floor 4	FS 801	CGW	Tusayan	Fig. 248
			FS 802	TGW	Tusayan	Fig. 248
			FS 732	TGW	Tusayan	Fig. 249
South Plaza	PII	Floor surface	FS 1360	TGW	Tusayan	Fig. 250
Floor (130)		extending over	FS 1361	TGW	Tusayan	Fig. 250
		much of South	FS 1382	TGW	Moenkopi	
		Plaza	FS 129	TGW	Finger-grooved	Fig. 251
			FS 573	TGW	Tusayan	Fig. 251
South Plaza, Prov.	EPIII	Pots associated	FS 1529	TGW	Tusayan	
184 in "D" grids		with floor surface	FS 1498	CGW	Tusayan	Fig. 252
		found to the east	FS 1460	CGW	Tusayan	Fig. 253
			FS 1461	TGW	Tusayan	Fig. 253
			FS 1462	TGW	Coconino	Fig. 253
			FS 1434	TGW	Plain	
Room 29 (1318)	EPIII	Floor 5	FS 2041	TGW	Tusayan	Fig. 254
			FS 2042	TGW	Tusayan	Fig. 254
Room 29 (1258)		Burial 11	FS 1870	TGW	Indeterminate	Fig. 247
			FS 1872	XGW	Moenkopi	Fig. 247
			FS 1883	TGW	Indeterminate	Fig. 247
			FS 1890	XGW	Indeterminate	Fig. 247

Table 171. Temporal distribution of metric attributes of whole, partial and restored utility vessels.

		PII	*EPIII*	*MPIII*	*LPIII*	*Total PIII*
Coil width	No. of cases	14	8	4	10	24
	Average (mm)	6.1	5.5	5.5	5.8	5.75
	Range (mm)	4–9	4–6	4–6	4–9	4–9
Distance	No. of cases	13	6	3	9	20
between	Average (mm)	9.5	7.7	5.7	7.7	7.7
indentations	Range (mm)	5–15	6–9	5–6	6–12	6–12
Depth of	No. of cases	13	6	2	9	19
indentations	Average (mm)	1.6	1.5	1.2	1.4	1.4
	Range (mm)	1.2–2.0	1.0–1.8	1.1–1.2	.1–2.5	.1–2.5

Table 172. Temporal distribution of size attributes for whole, partial and restored utility vessels.

		PII	*EPIII*	*MPIII*	*LPIII*	*Total PIII*
Maximum	No. of cases	12	7	5	9	23
Diameter	Average (cm)	29.9	31.2	19.1	24.7	26.4
	Range (cm)	19–35	22–37	9–29	19–33	9–37
Maximum	No. of cases	12	7	5	9	23
Height	Average (cm)	31.6	34.2	17.5	21.8	26.5
	Range (cm)	14–43	26–39	7–26	15–32	7–42
Volume	No. of cases	10	6	5	6	19
	Average (ml)	13,720	14,883	3720	6979	10,441
	Range (ml)	3200–23450	6900–22,300	450–7100	2450–13,000	450–27,800

Table 173. Temporal distribution of rim attributes for whole, partial and restored utility vessels.

		PII	*EPIII*	*MPIII*	*LPIII*	*Total PIII*
Rim Diameter Exterior	No. of cases	8	7	6	6	21
	Average (cm)	21.6	24.9	16.7	18.3	20.7
	Range (cm)	15–27	18–30	9–21	13–23	9–30
Amount of Rim Obliteration	No. of cases	8	8	3	2	15
	Average (cm)	3.4	2.7	2.1	2.0	2.6
	Range (cm)	2–5	2–3	2–3	2–3	2–5
Rim Description (see Appendix J)	No. of cases	10	8	6	6	
	Mode	IB3	IB3	IB2, IC3	IC3	



Figure 255. Basketmaker III utility vessels from the South Plaza.

Figure 256. Late PIII utility vessels from Antelope House.



Table 174. Description of whole, partial and restored utility vessels (*see Appendix J).

Field Specimen Number	Provenience	Ware/Type*	Feature	Floor	Rim Type*	Rim Diameter (cm)	Temper		Exterior Sooting	Interior Sooting	Subtype*		
Basketmaker III													
946	K3 Test 715	TGW LIN							x				
1391	Str 67 1102	TGW LIN							x	x			
1392	Str 67 1102	TGW LIN							x	x			
1383	Str 71 1111 or 1119	TGW LIN							x				
1384	Str 71 1115	TGW LIN							x	x			
1385	Str 71 1119	TGW LIN							x	x			
1455(2)	Str 71 1111	TGW LIN											
1457	Str 71 1111	TGW LIN											
Pueblo I													
531	Room 16 580	TGW TUS		x	1B2	19	SA		x		1	17	
Pueblo II													
1712	Rm 75 1208	TGW TUS	x		1B-	20	SA		x		1	17	
1715	Rm 75 1214	TGW TUS	x				SA		x			17	78
1450	E334 175	TGW TUS	?	?	1D3		SA		x		1	17	
1361	F545 130	TGW TUS		x			SA		x			17	
1360	F344 130	TGW TUS		x	1B3		SA		x		1	17	
566	F245 126	TGW TUS	?	?	1B2	24	SA		x		1	17	
1382	E348 130	TGW MOE		x	1C3	23	SA		x				7
129	F245 130	TGW IND		x			SA		x				78
573	F344 130	TGW TUS		x			SA		x			17	78
1939	Rm 1 1239	TGW TUS	?	?	1B3	27	SA		x		1	17	
732	Rm 21 352	TGW TUS	?	?	1B3	17	SA		x		1	17	
800	Rm 21 369	TGW TUS		x	1B3	24	SA		x		1	17	78
801	Rm 21 369	CGW TUS		x	1C3	23	VO	SA	x		1	17	
802	Rm 21 370	TGW TUS		x	1B3	15	SA		x		55	17	66
For PII:													
Totals:						173							
Means:						21.63							
Early Pueblo III													
1529	D351 184	TGW TUS			1A10	18	SA		x		1	17	
1498	D343 184	CGW TUS					VO		x	x	14	17	15
1460	D442 184	CGW TUS			1B3	30	VO		x		1	17	
1461	D342 184	TGW TUS			1B3	28	SA		x		1	17	
1462	D342 184	TGW CDC			1B3	26	SA		x		1		49
1434	D334 184	TGW IND PL					SA		x		1		
549	F351 184	TGW IND			1C3	26	SA		x		1		20
2042	Rm 29 1318	TGW TUS		x	1B3	28	SA		x		1	17	
2041	Rm 29 1318	TGW TUS		x	1D3	18	SA		x		1	17	14
113	M543-44 410	TGW IND			1B3		SA		x		1		78
For EPIII:													
Totals:						174							
Means:						24.9							
Middle Pueblo III													
1711	F151 123	CGW TUS					VO		x			17	
1938	Rm 22 1292	TGW MOE			1C3	20	SA		x		1	17	7
1870	Rm 29 1258	TGW IND	x		1D3	21	SA		x				20
1872	Rm 29 1258	XGW MOE	x		1C3	14	SH	SA	x				7
1883	Rm 29 1258	TGW IND	x		1B2	9	SA						20
1890	Rm 29 1258	XGW IND	x		1B3	12	SH		x				20
1864	Rm 30 1275	TGW MOE		x	1B2	21	SA		x		1		7
For MPIII:													
Totals:						97							
Means:						16.2							

Direction of Coil	Coil Width	Average Width of Coil	Distance Between Indentations	Depth of Indentations	Overall Design	Shape	Maximum Diameter	Interior Height	Volume (ml)	Amount of Rim Obliteration	Room Block
						Seedjar	21.6	15.5	3,400		
						Seedjar					
						Jar with handle					
1	7	1	10	11	5		24.0	28.0	8,700	17	N
1	5	1	8	15	5				13,300	45	S
1	6	0	15	17	2		41.0	43+			S
1	5	1	5	16	5						
1	4	1	8	15	4		29.7	32+	15,250		S
1	7	1	10	13	2		34.6	38.5+	23,350	25	S
1	4	1	9	16	4		27.0	32.0		55	S
1	6	2	10	14	5		30.8	29.7			S
1	7	1					34.0	38+	21,050		S
1	9	1	10	17	5		29.6	30+	21,050		S
1	5	1	8	16	3		34.6	40.2	23,450	40	S
1	7	1	9	17	4	Pitcher	18.5	18.5	3,200	25	S
1	8	1	13	20	2		26.4	33.0	12,100	23	S
1	5	1	8	15	4		21.5	31.0	10,150	19	S
1	8	2	11	12	5		19.5	13.6	2,350		S
	86		124	203			347.2	379.5	137,200	269	
	6.14		9.54	15.62			29.93	31.63	13,720	33.63	
1	6	2	9	17	5				7,650	24	S
1	5	1	7	18	2						S
1	6	1	6	15	4		31.7	38.5	20,600	25	S
1	6	1	8	16	4		36.8	35.0		25	S
	4	1					28.0	35.8	15,000	30	S
											S
							35.5	35.8	22,300	25	S
1	6	1	7	10	2		33.5	38.5		30	S
1	5	1	9	13	3		22.3	26.1	6,900	25	S
	6	1					30.9	37+	16,850	30	N
	44		46	89			218.7	246.7	89,300	214	
	5.5		7.7	14.8			31.24	35.24	14,883	26.8	
1	4	1	5	11	5						S
1	6	1	6	12	5				7,100	18	S
							29.0	26.0		18	S
1	6	1	6		1		18.0	16.0	2,400		S
						Mug	9.0	7.3	450		S
						Small pitcher	17.3	15.4	2,050		S
1	6	1			1		22.4	22.6	6,550	23	S
	22		17	23			95.7	87.3	18,600	64	
	5.5		5.7	11.5			19.14	17.5	3,720	21.3	

continued

Table 174. Description of whole, partial and restored utility vessels (*see Appendix J.)—Continued

Field Specimen Number	*Provenience*	*Ware/Type**	*Feature*	*Floor*	*Rim*		*Temper*		*Exterior Sooting*	*Interior Sooting*	*Subtype**		
					*Type**	*Diameter (cm)*							
Late Pueblo III													
1631	F452 122	TGW MOE			1C3	18	SA		x				7
242	Rm 22 327	TGW KTS		x			SA		x		1		8
1824	Rm 29 1268	XGW TUS	x		1B3	21	SH	SA	x			17	15
1857	Rm 29 1269	SGW MOE			1C3	13	SH	SA	x		1		7
762	Rm 50 634 (630)	SGW TUS		x	1B3	18	SH		x			17	15
2188	Central Plaza Annex 1516	TGW TUS		x			SA					17	
577a	N3252 600	TGW TUS					SA	SH	x			17	
577b	N352 600	TGW TUS					SA	SH	x			17	15
2209	Central Plaza 1566	TGW TUS			1B4	23	SA		x			17	15
1511	Rm 18 1144	TGW TUS	x		1C3	17	SA		x			17	
1512	Rm 18 1144	TGW TUS	x				SA	VO	x			17	78
For LPIII:													
Totals:						110							
Means:						18.3							
Dated to PIII Only													
1032	N343-44 827	TGW TUS	x		3B2	28	SA		x		1	17	
1038	N343-44 812/849	TGW MED	x		1B3	25	SA		x		1	17	49/15
For all PIII:													
Total:													
Mean:													
Navajo													
635	Rm 47 604												
1434	D334 184												
21(cc 1362)	Rm 9 42												
No Dates/Mixed Dates													
2192	S. Plaza 1446	TGW TUS			1B3	23	SA		x		1	17	
1712(?)		TGW TUS			1B3	23	SA		x		1	17	
1510 + 1527	D245 157	TGW TUS			1C4	25	SA		x		1	17	
1530 + 1603	D551 183	TGW IND			1C3	28	SA		x		1		78
2149	S. Plaza 1433	XGW TUS			1B3		SH	SA	x		1	17	15
1407	F331 178	TGW IND					SA		x				79
1482	E333 185	CGW TUS					VO		x			17	
2132	D3 Test 1421	TGW LIN					?		x				

Direction of Coil	Coil Width	Average Width of Coil	Distance Between Indentations	Depth of Indentations	Overall Design	Shape	Maximum Diameter	Interior Height	Volume (ml)	Amount of Rim Obliteration	Room Block
1	9	0			1		23.3	19.5	5,275		S
							31.5	23+			S
1	4	1	9	12	5		26.6	24.5	10,000		S
1	7	1	7	6	1		18.5	15.0	2,450	15	S
1	4	1	6	10	5				6,375		C
1	5	1	6	11	5		25.2	21.5			C
1	5	1	6	11	5		23.0	16+			N
1	5	1	6	19	5						N
1	6	1	6	15	5		33.3	31.5	13,000		C
1	7	2	12	16	2	Pitcher	20.5	21.5		25	N
1	6	2	11	25	2		20.0	23.5+	4,775		N
	58		69	125			221.9	196.0	41,875	40	
	5.8		7.7	13.9			24.7	21.8	6,979.2	20	
1	8	1	12	14	2		37.0	42.5	27,800	25	N
1	6	1	9	14	2		33.5	36.0	20,800	47	N
							535.4				
							26.8				
						Whole vessel					
						Basal sherd					
						Pot base & side					
1	7	1	8	20	2		23.0	27.0	9,250	30	S
1	6	1	10	10	7		22.2	34.0	11,300	14	
1	7	1	7	13	2					28	S
	7	0								23	S
1	6	1	5	11	5	Pitcher					S
	7	1									S
2	5	1	7	13	5	Seedjar					S

Table 175. Volumes of whole, partial and restored utility vessels.

Volume (liters)	*Number of vessels*	*Percent of vessels with measured volume*
under 2	1	3.0
2– 3.5	6	18.2
4–17	19	57.6
20–24	6	18.2
over 27	1	3.0

Room Block
Repair Material
Type of Hole Manufacture
Number of Holes
Noncritical
Critical

Room Block
Repair Material
Type of Hole Manufacture
Number of Holes
Noncritical
Critical

liters); one vessel has a volume of less than 2 liters and one a volume of over 27 liters. Figure 257 shows how whole vessels group into five fairly discrete categories of volume: under 2, 2–3.5, 4–17, 20–24, and over 27 liters (Fig. 258 shows a jar of the latter group).

Rohn (1971: 144) found four other groupings of volume for corrugated vessels at Mug House, Mesa Verde: less than 2, 2.5–7, 12–25, and 33–35 liters. None of the latter group were found as whole vessels at Antelope House. Vessels with volumes between, rather than within, Rohn's groups (at 7–12 liters, for example) do occur. Although it is obvious that small vessels, such as mugs and pitchers, served different purposes than did larger vessels, their specific functions remain unclear. Some standard categories of size may have existed at Antelope House, as evidenced by the occurrence of three sizes of very similar Late PIII pots, each combining indented with unindented coils and having similar shapes (Fig. 256). The number of whole vessels from Antelope House is too small to test whether these volume groupings had any prehistoric significance.

From context of recovery, the large jars appear to have been used both for cooking and for storage. Nearly every whole vessel, including those in obvious storage situations, is heavily sooted on the exterior. Setting a used cooking vessel into the surface of a room floor or open area as a storage container may have been a common practice. The two unsooted Pueblo vessels are a mug from Burial 11 and a jar containing rock salt found in the annex to the Central Plaza near Room 81, a ceremonial structure (Fig. 247, 259, 260). Chapter 25 discusses the functions of these vessels on the basis of their pollen contents.

Finally, rim shape may be related to function. Cummings (1940: 80) states that outcurving rims may indicate a cooking vessel, since such rims make for easier ladling and pouring. Straight rims would function better for storage of dry goods. Rim shape also may be a trait associated with different wares (Kidder 1924: 61), or with temporal or stylistic change. The only major change in rim shape at Antelope House is the temporal trend to an increase in everting; the behavioral correlates of this change remain unexplained.

Recycled Sherds

Worked, worn or repaired sherds are not prevalent among the utility ceramics from Antelope House. Only 140 of the 72,657 utility sherds (about .19 percent) were recycled. Of these, only 25 occur in critical proveniences. The rest were identified during the total sherd count for the excavation.

The following discussion deals with two categories of recycled sherds: repaired, identified by repair holes and/or binding material, and worked, which are modified and unmodified sherds with edge wear. Owing to the few instances of recycling, particularly in sampled proveniences, this section is primarily descriptive, although some discussion of the behavioral aspects of ceramic recycling is included.

Figure 257. Distribution of volumes for Anasazi utility vessels from Antelope House; each dot represents one vessel.

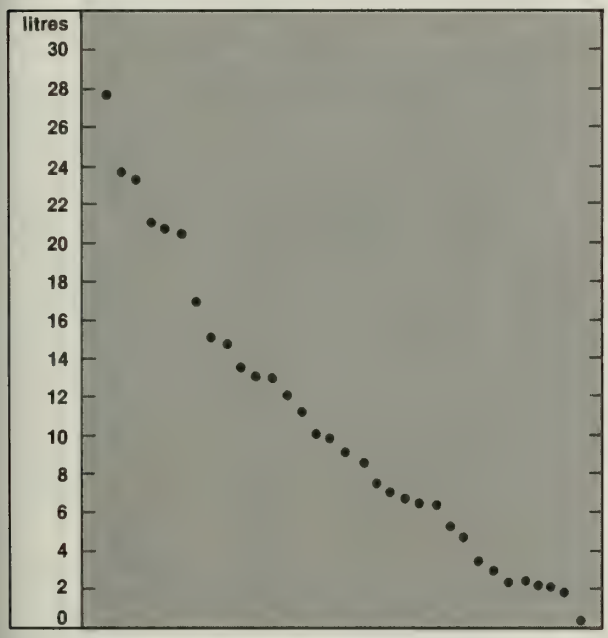


Figure 258. A utility vessle of the 27+L volume class.



Figure 259. Top view of jar containing rock salt from the annex to the Central Plaza near Room 81, a ceremonial structure.



Figure 260. Side view of jar pictured in Fig. 259.



Table 176. Summary of repaired utility sherd data (*see Appendix J).

Provenience			Comments	Ware/Type*	Temper 1st	Temper 2nd	Temper 3rd	Subtypes*						Rim Description	Period	
Corrugated Sherds																
Rm 29 1318	x			CGW KAN	VO					10	1	O			EPIII	S
RM 29 1318	x			TGW TUS	SA			1	17		1	O	x	IC3	EPIII	S
RM 29 1318	x			TGW TUS	SA				17		1	O			EPIII	S
Rm 30 1193	x			TGW TUS	SA				17		1	O			MPIII	S
C. Plaza 220	x			TGW TUS	SA				17		1	?			LPIII	C
C. Plaza Annex 764	x			XGW MOE	SH					7	1	B			EPIII	C
Rm 77	x															
1225–1228				TGW MOE	SA			1	17		?	?		ID10	EPIII	S
Kiva D 170	x			CGW TUS	RO				17	15	?	?			PII	S
S. Plaza 140	x			TGW TUS	SA				17		1	O			PII	S
Rm 83 1446	x			CGW TUS	RO				17	15	1	O	x		EPIII	S
S. Plaza 123		x	Possible Pre-fired hole	TGW TUS	SA			1	17		1	B		IB10	MPIII	S
Rm 5 896		x		TGW TUS	SA	SH			17		1	?	x	IB7	LPIII	N
N445 963		x		TGW KAN	SA					10	?	0			PI	N
Rm 49 609		x		CGW IND	RO			1	14	43	1	?	x	IB3	?	N
Rm 49 609		x	Seedjar?	CGW TUS	RO			17		1	0				?	N
Rm 48 617		x	Pendant?	TGW IND	SA					78	1	O			LPIII	C
Rm 18 562		x		TGW MOE	SA					7	2	O			LPIII	N
Kiva D 167		x	Bowl?	TGW TUS	SA	RO			17	12	1	O		IA2	PII	S
Kiva D 167		x	Mend?	TGW TUS	SA			1	17		1	I		IIIC3	PII	S
Kiva D 167		x	Mend?	TGW TUS	SA				17		2	O			PII	S
Rm 29 1317		x		TGW TUS	SA			1	17		2	O		IC10	EPIII	S
Rm 1 1240		x		TGW TUS	SA				17		1	O			PII	S
Rm 46 601		x		XGW TUS	SH				17		1	O		IB3	?	N
Rm 72 180		x		CGW TUS	RO				17		1	O			PII	S
Rm 29 1302		x		TGW IND	SA			1		78	1	O		IB3	LPIII	S
Rm 29 1289		x		LCG MOE	SH					7	1	O			MPIII	S
Rm 46 608		x		XGW TUS	SH	SA			17		1	O		IB3	?	N
Rm 83 1442		x		TGW TUS	SA			1	17		1	I		IIIB3	EPIII	S
Rm 29 1254		x		TGW MOE	SA			1		7	1	O		IB3	LPIII	S
Rm 29 1254		x	Pendant?	TGW KTS	SA	SH				8	1	O			LPIII	S
Rm 16 506		x		TGW TUS	SA	SH			17		1	O		IB7	LPIII	N
Rm 23 1403		x		TGW MOE	SA					7	3	O			LPIII	S
Rm 1 330		x		TGW TUS	SA	SH			17		1	O	x		LPIII	S
Rm 1 330		x		XGW KTS	SH					8	1	O			LPIII	S
Rm 18 574		x		XGW TUS	SH				17		1	O			LPIII	N
Kiva D 155		x		CGW TUS	RO				17		2	O			PII	S
Kiva D 155		x	Large holes	TGW IND	SA					78	2	O+I			PII	S
S. Plaza 183		x		TGW TUS	SA			1	17	78?	1	O		IC2	?	S
S. Plaza 123		x		TGW IND	SA			1		20	1	O	x	IB3	MPIII	S
S. Plaza 172		x		TGW MOE	SA					7	1	B			?	S
Rm 21 346		x		XGW MOE	SH	SA		1	60?	7	1	O+I		IC3	MPIII	S
Rm 21 341		x		TGW IND	SA	SH		1		78	1	?	x	IC3	MPIII	S
Rm 21 369		x		TGW IND	SA			1			1	I		IB3	PII	S
Rm 21 368		x		TGW IND	SA			1			1	I		IB3	EPIII	S
Rm 74 194		x		TGW KAN	SA	?				11	1	O			PI	S
S. Plaza 185		x		TGW KAN	SA	SH				11	1	O			?	S
C. Plaza 216		x		XGW MOE	SH					7	1	O			?	C
N245 523		x		XGW MOE	SH					7	1	O			LPIII	N
S. Plaza 123		x		TGW TUS	SA			1	17		1	O		IB2	MPIII	S
S. Plaza 155		x		CGW TUS	RO				17		1	O			?	S
S. Plaza 126		x		TGW TUS	SA			1	17		1	B		IB-	PII	S
Rm 21 338		x		TGW TUS	SA			1	17		1	O		ID3	MPIII	S
Rm 21 329		x		TGW KTS	SA					8	1	B			LPIII	S
N445 951		x		TGW KAN	SA					10	1	O	x		PI	N

Table 176. (Continued)

Provenience		Comments	Ware/Type*	Temper 1st	2nd	3rd	Subtypes*			Rim Description		Period	
S. Plaza 124	x		TGW TUS	SA			17	1	I			EPIII	S
Annex 761	x		TGW TUS	SA			17	1	O			EPIII	O
Plainwares													
Rm 2 771	x		TGW IND	SA				1	O			LPIII	S
Rm 5 893	x		TGW—	SA				?	?			LPIII	N
Rm 51 1130	x		TGW IND	SA				1	B	IB3		?	N
S. Plaza 122	x		XGW IND	SH				1	O	IB3		LPIII	S
Rm 72 186		x Possible pre-fired hole	TGW LIN	SA				1	B	IIA3		PII	S
Rm 16 580		x Seedjar?	TGW LIN	SA				1	O	IA3		PI	N
Rm 31 586		x	TGW IND	SA				1	O			MPIII	N
C. Plaza 218		x Small bowl	TGW IND	SA				2	O	IF2		LPIII	C
S. Plaza 1226		x	TGW LIN	SA				1	O			PII?	S
S. Plaza 184		x	TGW IND	SA				1	O	IA6		EPIII	S
Rm 16 578		x	CGW IND	RO				1	O	IA3		PI	N
S. Plaza 184		x Seedjar?	TGW IND	SA				1	O			EPIII	S
S. Plaza 192		x F.S. 1461	TGW IND	SA					O			EPIII	S
Rm 22 1192		x	TGW IND	SA					I			LPIII	S
Kiva A Trench		x	XGW IND	SH					O		x	PI	S
S. Plaza 157		x Seedjar	TGW IND	SA					O	IF7		?	S
N543–44 886		x Corrugated jar rim	TGW IND	SA					B			PI	N
S. Plaza 303		x	TGW IND	SA	SH				O	IA3		?	S
Kiva D 167		Pre-fired hole	TGW LIN	SA					?	IA3		PII	S
S. Plaza 185		Seedjar	TGW IND	SA					O	IA3		?	S

Repaired Sherds

Seventy-six sherds with repair holes were identified, 14 from critical proveniences. Two restored vessels (FS 1461 and FS 1939) also were repaired. Table 176 summarizes the information on repaired sherds, including provenience, date, ware, type, subtype and nature of repair. Most repaired sherds are corrugated; only 20 are plainwares. Thirty of the repairs occur on rim sherds; three of these, however, appear to be pre-firing holes, made to allow the pot to be suspended. Ladling, stirring and the use of stone lids may have caused more cracks and breaks near the rims of cooking and storage vessels than elsewhere, or rim breaks may have been considered easier to repair than more extensive breakage.

There are seven sherds with more than one repair hole and four with unfinished repair holes. Most holes were worked from the exterior of the sherd only, although six show evidence of drilling from both sides (Fig. 261). Nine sherds retain pieces of repair material wound through the holes; materials include rawhide, *Yucca baccata* and *Rhus trilobata*.

FS 1939, a reconstructed whole vessel, is an example of a large utility pot with extensive prehistoric repair (Fig. 262). The pot has four sets of two repair holes. This vessel comes from a PII provenience in Room 1 (1239), between Floors 3 and 4. It is a Tusayan Gray Ware of the Tusayan type, the most commonly found utility pottery type at Antelope House. Exterior sooting shows its probable use in cooking; the sandstone lid associated with it suggests a storage function. This case of multiple repair illustrates the difficulty of determining the number of repaired vessels from sherd data.

The plaza area south of the South Room Block yielded more than 20 percent of the repaired sherds. Ceremonial structures (Kiva D, Room 18 and Room 23) yielded 10 repaired sherds, or 13 percent of the total. These proveniences represent secondary refuse, however, and the present state of knowledge about the formation processes which produce such proveniences limits the valid inferences that can be made.

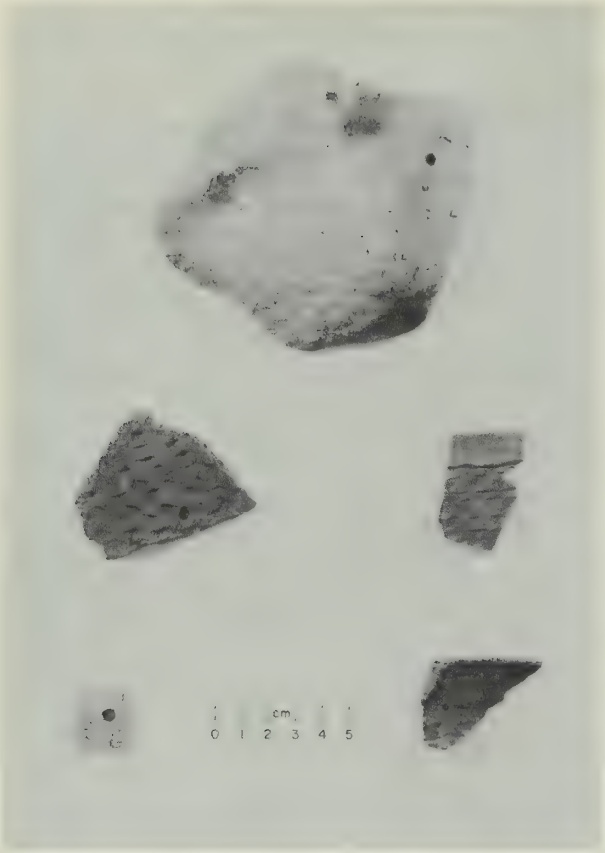


Figure 261. Examples of utility sherds with repair holes; that at top is from Room 23, the others from Kiva D.



Figure 262 (above). Tusayan Gray Ware utility vessel from a PII provenience in Room 1. Reconstructed whole vessel has four sets of two repair holes, evidencing extensive prehistoric repair.

Table 177 represents the distribution of repaired utility sherds by ware and type. Testing the correlation between the value of a ware and its frequency of repair, as was done for the decorated ceramics (Chapter 21), is not possible using these data. The number of repaired sherds from critical proveniences is very small (14), and no temper/ware identification was done for sherds from noncritical proveniences.

The occurrence of repaired utility sherds certainly is not common; some technological factors that may have contributed to this scarcity are mentioned in Chapter 21. However, enough "value" of some kind was attached to some utility vessels to cause attempts to prolong their usefulness. The few instances of repaired utility vessels may represent different economic statuses of family groups, seasonal availability of cooking/storage pots (new pots unavailable in the off-season of manufacture), or changes in the economic situation of the community as a whole.

The distribution of repair through time may relate to the latter possibility. Sixty-three repaired sherds could be dated to PI, PII, Early PIII, Middle PIII or Late PIII (Table 178). The number of repaired sherds is greatest in Late PIII. However, the percentage of total sherds in a given period represented by repaired sherds indicates an increase in repair from PI to Early PIII and a decrease thereafter. This trend is unlike that found for the decorated ceramics, which exhibit an increase in repair from PI to PIII. Differential recycling of decorated and undecorated ceramics is evident, but the causes of this need to be explored at a number of sites.

Worked Sherds

Sixty-four utility sherds (about .09 percent) are categorized as worked. Eleven are from critical proveniences and 44 are corrugated. As expected from the general ware distribution, the majority of worked sherds are Tusayan Gray

Table 177. Distribution of repaired utility sherds by ware and type.

	Ware			*Type*					*Indeterminate*
	CGW	*TGW*	*XGW*	*LCG*	*Kana'a*	*Tusayan*	*Moenkopi*	*Kiet Siet*	*Corrugated*
# of sampled sherds	3	9	2	0	1	7	2	0	0
# of nonsampled sherds	6	47	8	1	4	23	8	3	8
Total # of repaired sherds	9	56	10	1	5	30	10	3	8
% of total repaired sherds	11.8	73.7	13.2	1.3	8.9	53.6	17.9	14.3	5.6

* See Appendix J for description of types.

Table 178. Temporal distribution of recycled utility sherds.

	BMIII	*PI*	*PII*	*EPIII*	*MPIII*	*LPIII*	*Navajo*	*Indeterminate Date*
Total # of utility sherds	455	4470	6715	6181	9668	30,332	—	—
# of repaired sherds		7	14	14	9	19	—	13
% of total sherds		.15	.20	.22	.09	.06	—	—
# of worked sherds	1	3	7	6	9	21	1	16
% of total sherds	.02	.06	.10	.09	.06	.06	—	—

Table 179. Distribution of worked utility sherds by ware.

	XGW	*CGW*	*TGW*	*LCG*	*Indeterminate Date*
# of worked sherds	8	1	44	8	3
% of worked sherds	12.5	1.5	69.8	12.5	4.7

Ware of the Tusayan type (Table 179). The fairly high proportion of Little Colorado Gray worked sherds was unexpected. Table 180 summarizes descriptive data for the worked utility sherds.

Worked sherds show evidence of edge wear from use and/or from shaping by grinding or chipping. Most of these sherds are irregular shapes, with working on one or more edges. They probably functioned as scrapers. No detailed analysis of edge wear was undertaken. Some of the worked sherds, especially those which appear to be ladle rims, may not be cases of recycling, but of wear which occurred when the vessel/ladle was whole. This is possible in four cases.

Four sherds worked into geometric shapes may have functioned as gaming pieces or as pendants, although none are perforated. An example is a Little Colorado Gray Ware sherd of the Honani type from Room 57 (see Fig. 263).

Other types of recycling occur. Large sherds, many with beveled edge wear, may have been reused as scoops. Five basal, or large, sherds with soot or pitch deposits appear to have functioned as "burners" or as containers for pitch (Fig. 264).

Worked utility sherds occur throughout the site, both in open areas and in rooms. Eleven sherds (17.2 percent of the total worked) are from ceremonial structures (six from Kiva D, four from Kiva C, and one from Room 81).

About 33 percent of the worked sherds are dated to Late PIII (Table 178). The percentage of worked sherds in the utility pottery of each pe-

Table 180. Summary of data on worked utility sherds (*see Appendix J).

Provenience	Critical	Noncritical	Ware*	Type*	Temper* 1st	Temper* 2nd	Subtypes*	Type of Reuse: Chipping	Type of Reuse: Grinding	Type of Reuse: Wear	No. of Edges Showing Reuse	Shape of Reused Edge, Curved or Straight	Date	Room Block	Comments
Corrugated Sherds															
Rm 29 1318	x		TGW	TUS	SA		17		x	x		C	EPIII	S	
J252 263	x		XGW	TUS	SH		17			x	2	C	LPIII	S	Basal sherd
S. Plaza 122	x		XGW?	TUS	SH		17		x	x	1	C	LPIII	S	Basal sherd
Rm 57 768	x		LCW	HON	SA		10 62				3	C	LPIII	C	
Rm 57 768	x		TGW	TUS	SA		17		x	x	1	C	LPIII	C	
Rm 81 1527	x		TGW	MOE	SA		7		x		All	C	LPIII	C	
Rm 29 1169	x		TGW	KTS	SA		8		x		1	C	LPIII	S	
Rm 5 1124	x		TGW	KTS	SA		17		x		1	C	LPIII	N	
Rm 5 1120	x		XGW	TUS	SH		17		x		2	S	LPIII	N	3 sherds mend
Rm 29 1173	x		XGW	TUS	SH		17		x		All	C	LPIII	S	
Kiva D 155		x	TGW	IND	SA		78	x			1	C	PII	S	
Kiva D 155		x	TGW	TUS	SA		17	x			1	C	PII	S	
Kiva D 155		x	TGW	TUS	SA		17	x			1	C	LPIII	N	
Kiva D 155		x	TGW	KAN	SA		7				2	C	PII	S	
Rm 28 446		x	TGW	TUS	SA		17	x			1	C	LPIII	N	
Rm 22 1297		x	TGW	TUS	SA		17		?	x	1	C	EPIII	S	Basal sherd
Rm 1 1238		x	TGW	TUS	SA		17		x		2	S	PII	S	
S. Plaza 185		x	TGW	IND	SA		78		?	x	1	C	?	S	
S. Plaza 185		x	XGW	IND	SH		68	x			2	C/S	?	S	
Kiva C 719		x	TGW	TUS	SA		17		?	x	1	C	MPIII	C	
Rm 6 235		x	TGW	MOE	SA		7		x		2	C?	Navajo	N	
Rm 1 330		x	TGW	TUS	SA		17		x		All	C	LPIII	S	
Rm 30 1163		x	LCG	MOE	SA	RO?	7	x			1	C	MPIII	S	
P grids 826		x	?	MOE	RO	SA	7		x		1	C	?	N	
Rm 29 1171		x	XGW	TUS	SH		17		x		1	S	LPIII	S	
M551 845		x	TGW	TUS	SA		17		x	x	1	C	PI	N	From F.S. 1038
Rm 30 1198		x	LCG	MOE	SA		7	x	?		1	C	MPIII	S	
Rm 29 1302		x	?	TUS	?		17		x		3	C	LPIII	S	
Rm 79 1515		x	LCG	TUS	SA		17		x	?	1	C	LPIII	C	
Rm 46 601		x	LCG?	MOE	SH?		7		x	?	3	Irregular	?	N	
Rm 46 601		x	LCG	TUS	SA		17		x		1	C	?	N	
Rm 29 1293		x	TGW	IND	SA		20		x	x	1	C?	EPIII	S	
Rm 18 558		x	TGW	TUS	SA		17		x	x	1	S	LPIII	N	
Rm 46 608		x	TGW	IND	SA		20	x			1	C	?	N	

Rm 19 603		x	TGW	TUS	SA			17			x	x	1	C	LPIII	N	
Rm 29 1289		x	TGW	TUS	SA			17			x	x	1	C	MPIII	S	Basal sherd
Kiva D 167		x	TGW	TUS	SA			17			x	x	All	C	PII	S	Basal sherd
Kiva D 167		x	TGW	MOE	SA				7	x		x	1	C	PII	S	
Rm 29 1284		x	TGW	TUS	SA			17			x	x	1	C	MPIII	S	
Rm 7 624		x	TGW	KAN	SA				10		x	x	1	C	?	N	
Rm 7 494		x	TGW	TUS	SA	SH?		17			x	x	1	C	?	N	
Kiva B 216		x	TGW	KTS	SA				8			x	1	C	?	C	Ladle rim?
S. Plaza 157		x	TGW	MOE	SA				7	x			1	C	?	S	
Plainwares																	
Rm 5 1120	x		XGW	IND	SH						x	x	All	C/S	LPIII	N	
S. Plaza 185		x	TGW	IND	SA	SH					x	x	1	C	?	S	
S. Plaza 185		x	TGW	IND	SA					x	x		All	C	?	S	
K3 test 294		x	TGW	IND	SA						x	x	1	C	PI	C	Ladle rim?
Rm 50 611		x	LCG	IND	SA						x	x	2	S	LPIII	C	
Rm 74 197		x	TGW	IND	SA						x	x	1	C	PI	S	
Kiva C 277		x	XGW	IND	SH					x	x		1	C	MPIII	C	
Kiva C 277		x	TGW	IND	SA	SH?					x	x	1	C	MPIII	C	Basal sherd
Rm 74 184		x	TGW	IND	SA					x	x		All	C/S	?	S	
Rm 53 638		x	TGW	IND	SA						x	x	2	C	LPIII	C	
N grids 905		x	TGW	IND	SA						x	x	1	C	?	N	
N445 1059		x	TGW	IND	SA						x	x	1	C	?	N	
Rm 76 1223		x	RGW	IND	SA						x	x	2	S	EPIII	S	
Rm 47 1148		x	TGW	IND	SA						x	x	2	C/S	LPIII	N	
Rm 67 1103		x	?	IND	RO	SA					x		1	C	BMIII	C	
Rm 21 338		x	TGW	IND	SA					x			1	C	MPIII	S	
S. Plaza 184		x	TGW	IND	SA						x	x	1	C	EPIII	S	
S. Plaza 184		x	TGW	IND	SA						x	x	1	S	EPIII	S	
Rm 40 737		x	CGW	IND	RO						x	x	2	C/S	LPIII	C	
Tower Corridor		x	TGW	IND	SA							x	1	S	MPIII or EMPIII	S	Beveled edge
Other types of Reuse											**Type of Reuse**						
G134 122	x		TGW	TUS	SA		1	17			Pitch around edges				LPIII	S	Rim sherd
F141 155		x	TGW	IND	SA	SH					Sooted, burner?				?	S	Basal sherd
Rm 16 470		x	?	?	SH						Scoop for pitch?				?	N	Basal sherd
D451 183		x	TGW	IND	SA				79		Pitch container?				?	S	Beveled edge
F345 137		x	TGW	TUS	SA						?				PII	S	Basal sherd, beveled edge wear, 2 sherds mend



Figure 263. Worked utility sherds from Antelope House.

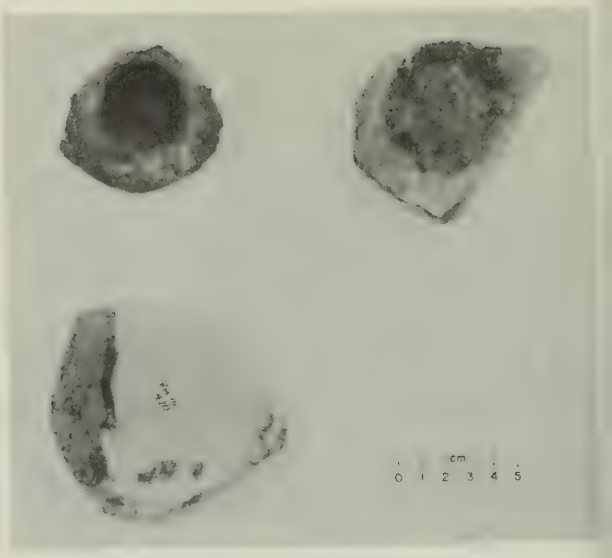


Figure 264. Recycled utility sherds with soot or pitch deposits from Antelope House.

riod, however, does not vary significantly, and does not show the temporal changes of the repaired utility sherds. Neither repaired nor worked utility sherds give evidence of recycling as an important component of the economic processes at Antelope House.

Chapter 23

Variability in Anasazi Utility Pottery

Although a number of ceramic traditions overlap in the Canyon de Chelly area, the common utility ware found at Antelope House is sand-tempered Tusayan Gray Ware (TGW) (Colton 1955). Sherds of this ware occur in high percentages throughout the Pueblo occupation. However, an unusual rock temper distinguishes a small percentage of the utility sherds. This proved to be a trachyte or sanidine basalt temper characteristic of Chuska Gray Ware from the Chuska Valley. A large amount of sherd-tempered pottery, here labeled Brand X Gray Ware (XGW), also occurs in Late Pueblo III provenience at the site.

Shepard (1968: 311) has stated that the temper used in pottery, or at least its primary ingredient, indicates conscious cultural choice. Given her observation, questions arise as to how much other variability there is between differently tempered wares and the kinds of cultural behavior represented by that variability. An attribute study of sherds with the temper types (trachyte, sand, sherd) found in Antelope House utility pottery promised to provide data for investigation of such activities as trade, migration and local ceramic production.

Objectives and Limitations

The primary aim of this study is to begin to show the usefulness of utility ceramic analysis for understanding prehistoric human behavior. Ceramic studies traditionally focus on decorated wares, particularly on the chronological and cultural changes revealed by styles of painted decoration. Although unpainted and generally considered undecorated, utility ceramics have a number of attributes which may be indicators not only of time-space relationships, but also of behavioral processes. My objectives are to demonstrate differences in stylistic and technical attributes of differently tempered utility ceramics and to discuss the possible significance of these differences. It is hoped that this study will encourage intensive investigation of the behavior represented by variability in utility wares.

This, then, is a preliminary investigative study, not a rigorous test of human behavior. Its validity is limited by the nature of the sampled data and by time restrictions. Sampling strategies developed prior to the formulation of this research problem determined the nature of the proveniences used. Only critical proveniences dated to the traditional Anasazi periods by absolute dating techniques and by architectural or decorated ceramic association provide data for this study. Any bias in representativeness incurred by using these units is similar to that for the other analyses in this volume. Sampled data consist primarily of sherds from refuse deposits. A more valid study could be done with whole vessels from primary proveniences or with better knowledge of patterns of discard behavior at Antelope House.

Chi-square (χ^2) is the basic test of significance used in this study. Higher powered par-

ametric statistical measures were investigated, but due to unexpected corrections in computerized data, these tests were invalidated and time did not permit recalculations.

Format of Analysis

The basic hypothesis investigated here is that variability exists among wares with regard to attributes of exterior surface appearance, as evidenced in utility sherds. In other words, characteristics resulting from stylistic choices and manufacturing techniques covary with temper type. It is possible that attributes making up "style" in utility pottery distinguish different wares, as in decorated ceramics. The general form of the statistical hypothesis is discussed below.

Null hypothesis (H_0): There is no association between ware, or temper type, and other attributes of utility sherds from Antelope House.

Alternate hypothesis (H_1): A significant association exists between temper type and other attributes of utility sherds from Antelope House.

Two basic sets of comparisons comprise the analysis. One deals with trachyte-tempered versus sand-tempered sherds, primarily in the Pueblo II period, and the other deals with sherd-tempered versus sand-tempered sherds in Late Pueblo III. A general description of the distribution of wares in space and time is presented first (see also Chapter 22). Each ware then is analyzed with regard to a number of features recorded on the computer forms. Observations are made of differences and similarities between wares based on comparisons of the numerical distribution of attributes. These comparisons are graphically illusted in Figures 265 through 276.

Chi-square (χ^2) tests are used to test the significance of the deviation of observed from expected frequencies of attribute occurrence. The level of significance set for these tests is d = .05. Table 181 presents the results of the χ^2 tests, showing which tests indicate an association between ware and other attributes greater than would be expected by chance alone. A summary of the results of these tests is followed by discussion of the possible causes of the variability detected.

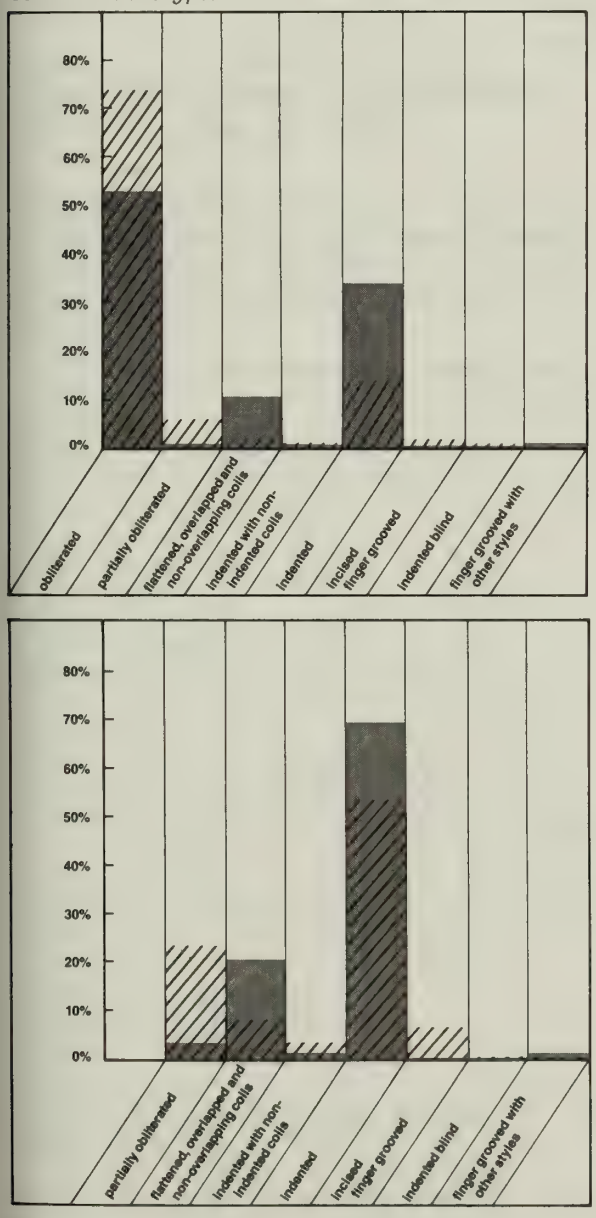
Table 181. Results of chi-square tests of the significance of the association of attributes with wares in utility sherds.

Variable cross classified with ware	x^2	*df*	*P*		*at d = .05**
CGW vs TGW—PII					
Subtype	18.4	4	.005>	P >.001	R
Direction of coiling	.65	1	.5 >	P >.3	NR
Coil width	12.66	2	.01 >	P >.001	R
Distance between indentations					
Group A	6.4	2	.05 >	P >.02	R
Group B					NR
Depth of indentations					
Ungrouped	30.6	4		P <.001	R
Grouped					NR
Overall surface design	16.97	3		P <.001	R
XGW vs TGW—LPIII					
Subtype	661.62	5		P <.001	R
Direction of coiling	41.46	1		P <.001	R
Coil width	191.69	1		P <.001	R
Distance between indentations					
Ungrouped	19.71	3		P <.001	R
Grouped	.74	1	.5 >	P >.3	NR
Depth of indentations	42.55	1		P <.001	R
Overall surface design	31.30	3		P <.001	R
Amount of rim eversion	8.35	3	.05 >	P >.02	R
Rim diameter	.50	1	.5 >	P >.3	NR
Sooting	51.9	1		P <.001	R

*Supports the null hypothesis being rejected (R) or not rejected (NR).

Attributes of sherds were selected for this study on the basis of applicability to the problem and ease of statistical manipulation of the data. Some attributes are not used simply because very few sherds have the attribute recorded. The variables used in comparison of wares are primarily stylistic in nature. They are: (1) subtype, (2) direction of coiling, (3) coil width, (4) distance between indentations, (5) depth of indentations, and (6) overall surface design of indentations. Other attributes also are used in analysis of specific questions about causes of variability. For example, presence or absence of sooting is studied in relation to functional differences of wares. Unfortunately, oxidation tests on the firing color of pastes, used to indicate local or nonlocal production of wares, were not within the range of our analyses. Appendix J and Chapter 22 describe each attribute and how it was measured or observed. The levels of the attributes used in the various χ^2 tests are shown in Table 182.

Figure 265. Subtypes of Tusayan and Chuska Gray Wares, including (above) and excluding (below) obliterated subtype.



The above variables are not invalidated as a result of being ware-dependent (see Whittlesey 1974: 106). In this analysis, wares are defined solely by temper type, and the attributes studied represent basic traits found in Anasazi utility ceramics of all temper types.

Metric variables are not analyzed separately for each type category. However, only for coil width does this seem to pose any obvious problem. Wider coils are correlated with the Kana'a type and smaller coils with the Tusayan type. Therefore, a ware with a high percentage of Kana'a necessarily will show a high percentage of wide coil width.

Most of the tests use weighted data in order to keep the analysis at the sherd level. Attribute data that would definitely be skewed by weighting, such as subtype and rim description, are unweighted in the χ^2 tests.

Comparison of Trachyte-Tempered and Sand-Tempered Wares

In the early 1900's, sanidine basalt (trachyte) temper was identified in utility and decorated sherds from Chaco Canyon and from La Plata (Hawley 1934: 36; Shepard 1939: 279–281). Since then, it has been noted in sherd assemblages from sites spread over a large part of the Four Corners area. This type of rock temper recently has been used to define a separate ceramic tradition called Chuska Wares (Peckham and Wilson n.d.; Warren 1967: 104).

Trachyte is an intrusive volcanic basalt temper; it appears as distinctive, glistening gray-green rock fragments in sherds. "Because of the limited areas in which sanidine basalt occurs along the eastern side of the Chuska Mountains,

it serves as an excellent indicator for the reconstruction of prehistoric economics. Sanidine basalt is so distinctive that it is readily identifiable in Chuskan pottery hundreds of kilometers from its source" (Windes 1977: 286). The status of this utility pottery as a tradeware from sources in the Chuska Mountains has been postulated for many years, especially for the Chaco area.

Chuska Gray Ware (CGW) is not abundant at Antelope House, never representing more than 23 percent of the total sherds in a given period. It occurs most frequently in PI and PII, which together account for nearly 64 percent of all CGW sherds in the sample. Tusayan Gray Ware (TGW), on the other hand, always constitutes more than 75 percent of all sherds in a given period, except in Late PIII. This sand-tempered ware is the prevailing Anasazi utility ware in northern Arizona.

Chuska Gray Ware is compared with Tusayan Gray Ware primarily in the PII period. Most PI utility sherds at Antelope House come from a few proveniences, notably from Room 1, Floor 5. This deposit is believed to be PI primary refuse, redeposited in Room 1 in PII times. A number of restorable vessels in these proveniences cause differences in attribute percentages between weighted and unweighted data. Because of this problem, PII analysis is emphasized and PI data are simply summarized in Table 183. For the PII period, CGW makes up 13.2 percent of the sampled sherds (n = 116) and TGW, 82.3 percent (n = 722). The number of sherds used in each comparison varies with the attribute analyzed.

Results of χ^2 Tests, CGW vs. TGW in PII

The specific hypothesis being tested in the PII ware comparison is: CGW and TGW sherds show significant difference in attributes of surface appearance; that is, these attributes covary

Table 182. Levels of the attributes used in the chi-square tests summarized in Table 181.

Attribute	*CGW vs TGW—PII Levels**	*XGW vs TGW—LPIII Levels**
Subtype	2, 3	1
	4, 5	2, 3
	15+17	4, 5
	8, 9, 11, 12	15+17
	7	10
		7
Direction of coiling	Right, left	Right, left
Coil width	1–4 mm, 5–7 mm, >7 mm	4–7 mm, 8–11 mm
Distance between Indentations:		
Group A	5–7 mm, 8–10 mm, >10 mm	3–5 mm, 6–8 mm, 9–11 mm, 11 mm
Group B	5, 6 mm, 7, 8 mm, 9, >10 mm, 10 mm	1–8 mm, >8 mm
Depth of Indentation:		
Group A	<.99 mm	1–3 mm
	1–1.49 mm	4–5 mm
	1.50–1.99 mm	
	2.00–2.49 mm	
	>2.49 mm	
Group B	<2.00 mm	
	>1.99 mm	
Overall Surface Design	Right, left, alternate, overlap	Right, left, alternate, overlap
Rim Description		A, B, C, D
Rim Diameter		11–19 cm, 20–28 cm
Sooting		Presence, absence

*See Appendix J.

with the two temper types. The null hypothesis states that there are no significant differences in this case. Table 181 shows which χ^2 tests did not exceed the specified significance level. The tests for the attributes of subtype, coil width, depth of indentation (ungrouped), overall surface design and distance between indentations (grouped) demonstrate significant variability between CGW and TGW and lend support to the hypothesis that these attributes are associated with temper type. Only the χ^2 for direction of coiling and two cases of grouped attribute data did not favor re-

Table 183. Distribution of attributes of Pueblo I Tusayan and Chuska Gray Wares.

Subtype		*Obliterated*	*Partially Obliterated*	*Flattened, Overlapping Coils*	*Flattened, Non-Overlapping Coils*	*Nonindented plus Indented Coils*	*Indented Coils*	*Finger-Grooved*	*Incised*	*TOTAL*
Ware										
CGW	number			18		1	3			22
	percent			81.8		4.5	13.6			
TGW	number	6	4	59	16	2	18	3	2	110
	percent	5.4	3.6	68.2		1.8	16.4	2.7	1.8	

Coil Width (mm)		1–3	4	5	6	7	8	9	10	>10	TOTAL
CGW	number			22	17	43	10	1	6	28	127
	percent			17.3	13.4	33.9	7.9	.8	4.7	22.0	
TGW	number	1		22	8	14	26	13	70	69	223
	percent	.4		9.9	3.6	6.3	11.7	5.8	31.4	31.0	

Depth of Indentation (mm)		Indeterminate	1.00–1.49	1.50–1.99	2.00–2.49	2.50+	TOTAL
CGW	number	83		10	34	2	46
	percent			21.7	73.9	4.3	
TGW	number	224	8	3	2	51	64
	percent		12.5	4.7	3.0	79.7	

Distance between Indentations (mm)		6	7	8	9	10	12	14	15	20	22	TOTAL
CGW	number			10	14			2				26
	percent			38.5	53.8			7.7				
TGW	number	1	6	4	1	1	1	22	1	1	26	64
	percent	1.6	9.4	6.2	1.6	1.6	1.6	34.4	1.6	1.6	40.6	

Overall Surface Design		Indeterminate	Continuous Right	Continuous Left	Alternate	Irregular	Overlap	TOTAL
CGW	number			24		2		26
TGW	number	8	7	18	2	2	30	67
Percent without indeterminate and irregular entries:								
CGW				100				
TGW			12.3	31.6	3.5		52.6	

Direction of Coiling		Right	Left	TOTAL
CGW	number	23	74	97
	percent	23.7	76.3	
TGW	number	18	19	37
	percent	48.6	51.4	

x^2 test = 7.9 at 1 df .01>P>.001. Reject null hypothesis at d = .05.

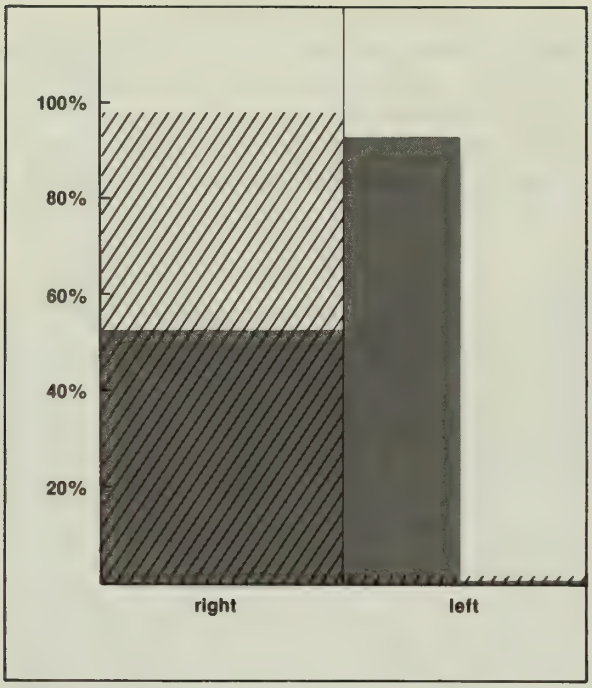


Figure 266. Coiling direction in Tusayan and Chuska Gray Wares.

jection of the null hypothesis. Briefly described below are the kinds of variability observed within the attribute classes.

Subtype one (Fig. 265)

The major differences in subtype are the higher percentages of the styles of flattened, non-indented coils, and of indented coils for CGW. This ware also has no cases of the varieties of incising and finger-grooving and few instances of partially obliterated indentations, unlike TGW.

Coil Width (Fig. 267)

Both CGW and TGW have their highest frequencies of occurrence of width of coil at 6 mm, but the distribution of CGW generally is skewed toward smaller coil widths; TGW shows a more normal distribution of coil width. Chuska Gray Ware has more than expected of the extremely small coil widths and fewer of the very large widths, while Tusayan Gray Ware shows the reverse pattern.

Distance Between Indentations (Fig. 268)

With data divided at 2 mm intervals, the χ^2 test for distance between indentations is not significant. However, χ^2 is significant for data grouped at 3 mm intervals. CGW has a bimodal distribution, with peaks at 7 mm and 9 mm. TGW again shows a more dispersed pattern, with highest percentages at 7 mm and 8 mm.

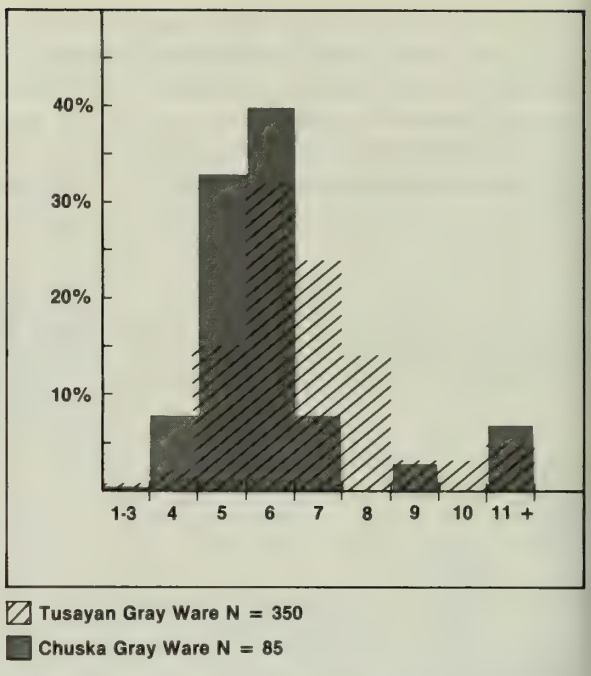


Figure 267. Coil widths in Tusayan and Chuska Gray Wares.

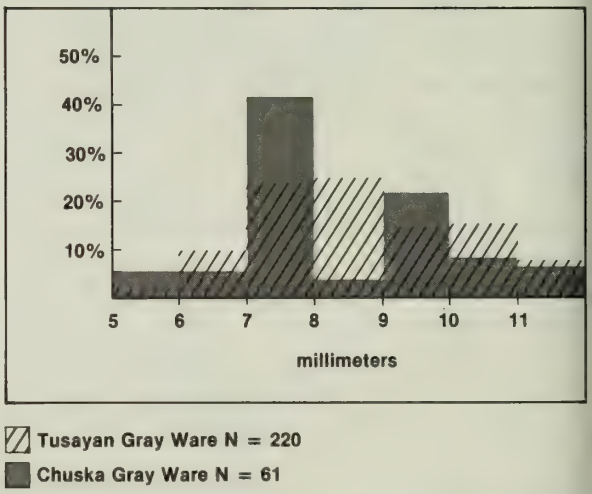


Figure 268. Distance between indentations in Tusayan and Chuska Gray Wares.

Depth of Indentation (Fig. 269)

CGW generally has shallower indentations than does TGW. The mean coil width is 2.54 mm

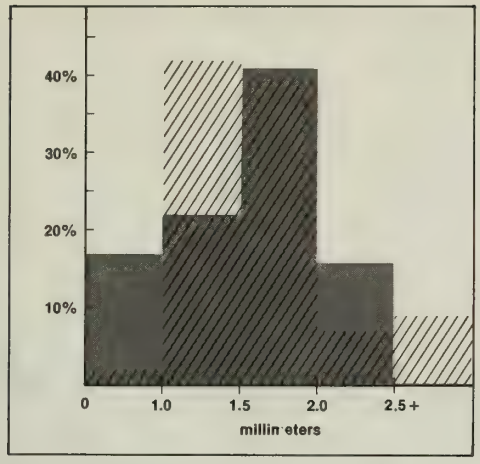


Figure 269. Depths of indentation in Tusayan and Chuska Gray Wares.

for CGW and 2.79 mm for TGW. For depth of indentation, the TGW sherds show a more restricted distribution than the CGW; depth for TGW is concentrated in the middle range of 1 to 2 mm. For the very shallow and very deep categories, TGW and CGW exhibit opposite trends. Data grouped into fewer than the five original intervals do not reveal a significant difference between the two wares.

Overall Surface Design (Fig. 270)

A large number of indeterminate and irregular entries for this attribute account for the small sample size. In a comparison of the four definite types of overall surface design, however, CGW presents a pattern of indentation alignment significantly different from that of TGW. Chuska Gray Ware has 47 percent alternate design, with the rest evenly divided between continuous right and continuous left. There are no occurrences of overlap in the CGW sherds sampled. Design styles for Tusayan Gray Ware are restricted to continuous right (63 percent) and alternate (31 percent), with a few cases of overlap and continuous left. In both the PI and PII periods, CGW tends to have a disproportionate amount of continuous left design.

Direction of Coiling (Fig. 266)

No significant difference in direction of coiling is evident in PII between CGW and TGW; both have 95 percent or more of coiling to the right. In PI, however, 76 percent of CGW is

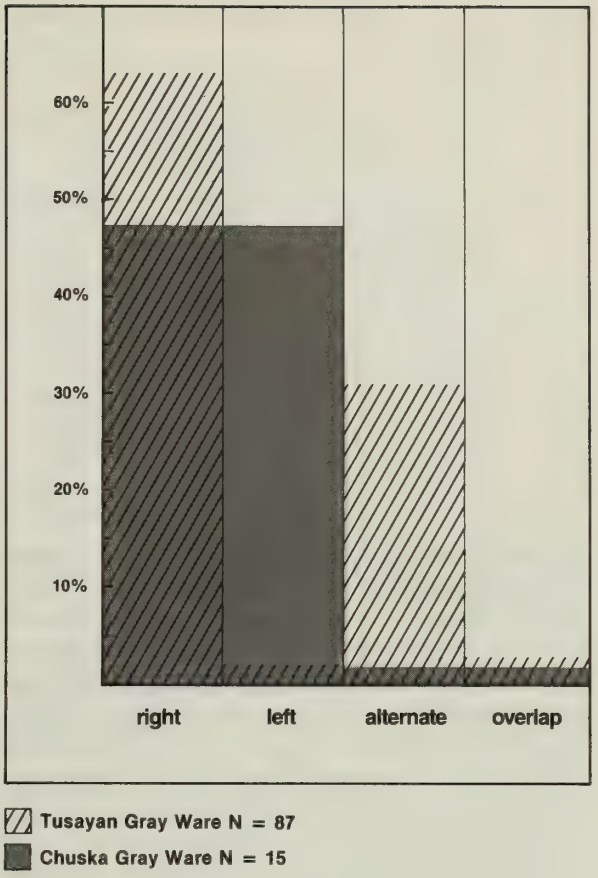


Figure 270. Overall surface designs (indentation alignment) in Tusayan and Chuska Gray Wares.

coiled to the left, compared with 51 percent for TGW. A χ^2 test indicates significant association of this attribute with ware (Table 183). This difference may represent actual ware variability during PI, or a sampling bias resulting from overcounting of a few restorable vessels from Room 1 proveniences. Shepard (1939: 278) found no evidence of association of coil direction with styles of indentation or period in La Plata sherds.

Rim Data (Table 184)

Study of rim descriptions and diameters is inconclusive because of the few PII sherds containing this information.

Summary

Overall, the χ^2 tests demonstrate an association greater than would be expected by chance alone of attributes of surface appearance with the temper types of sand and trachyte in PII utility sherds. These comparisons show CGW to have

Table 184. Rim data for Pueblo II Chuska Gray Ware and Tusayan Gray Ware sherds.

*Rim Description**								
CGW 13 rim sherds					*TGW* 48 rim sherds			
IA3 + LB3 = 69.2%					IA3 + IB3 = 64.6%			
Degree of Eversion: A = 3					Degree of Eversion: A = 17			
B = 8					B = 25			
C = 2					C = 5			
mode = IB3					E = 1			
					mode = IB3			
Rim Diameter (exterior) (cm)								
	14	16	18	20	22	24	30	TOTAL
CGW number		1						1
TGW number	1	1	1	2	1	1	1	8

* See Appendix J for explanation of codes.

higher percentages of continuous left and alternate design styles, small coil widths and shallow indentations. Significantly different distribution patterns of subtype and distance between indentations are evident when CGW and TGW are compared, but not of direction of coiling. A fairly restricted distribution of coil width and distance between indentations occurs in the CGW sherds; the same is true with regard to depth of indentation and overall surface design in the TGW sample. On the basis of this study, no evidence appears for a difference in degree of standardization of attributes of wares.

Comparison of Sherd-Tempered and Sand-Tempered Wares

A high percentage of sherd-tempered pottery, Brand X Gray Ware (XGW), appears at Antelope House in Late Pueblo III, along with the common sand-tempered Tusayan Gray Ware. More than 90 percent of all XGW sherds sampled were dated to this period. Prior to this time, the proportion of XGW sherds in the total assemblage of utility sherds never exceeds 8 percent. In Late PIII, TGW and XGW each constitute more than 40 percent of the total. The relatively sudden appearance of XGW occurs at a time when Mesa Verde White Ware also increases in frequency. This fact makes Late PIII an interesting period to study and the larger sample sizes make it an appropriate period for analysis.

One possible source of error lies in putting pottery tempered with sherd and smaller amounts of sand into the XGW ware category, and pottery tempered with sand and smaller amounts of sherds into TGW. However, sherd-and-sand-tempered pottery most likely results from a cultural choice of sherd for temper—sherds that happen to be sand-tempered—and so is behaviorally the same as sherd-tempered XGW. The sand-and-sherd-tempered TGW may also be the result of this process. Fortunately, only a very small number of sand-and-sherd-tempered sherds occurs in the sample.

Results of χ^2 Tests, XGW vs. TGW in Late PIII

The specific hypothesis being tested differs from the previous one only in the period and wares considered. Again, Table 181 shows the results of the χ^2 tests. These favor support of the hypothesis for all of the six main attributes analyzed, except for the case of grouped distance between indentations. Analysis of rim data is not so conclusive.

Subtype (Fig. 271)

Brand X Gray Ware shows higher than expected frequencies of the style of indented coils and of the unusual style of unindented coils in an overall indented pattern. Lower than expected frequencies are observed of obliterated, partially obliterated, and flattened nonindented subtypes for XGW. The opposite trends hold for TGW.

Most notable is the concentration of XGW sherds in the indented style, combined with a low percentage of sherds of obliterated style. This may indicate a prevalence of vessels of all-

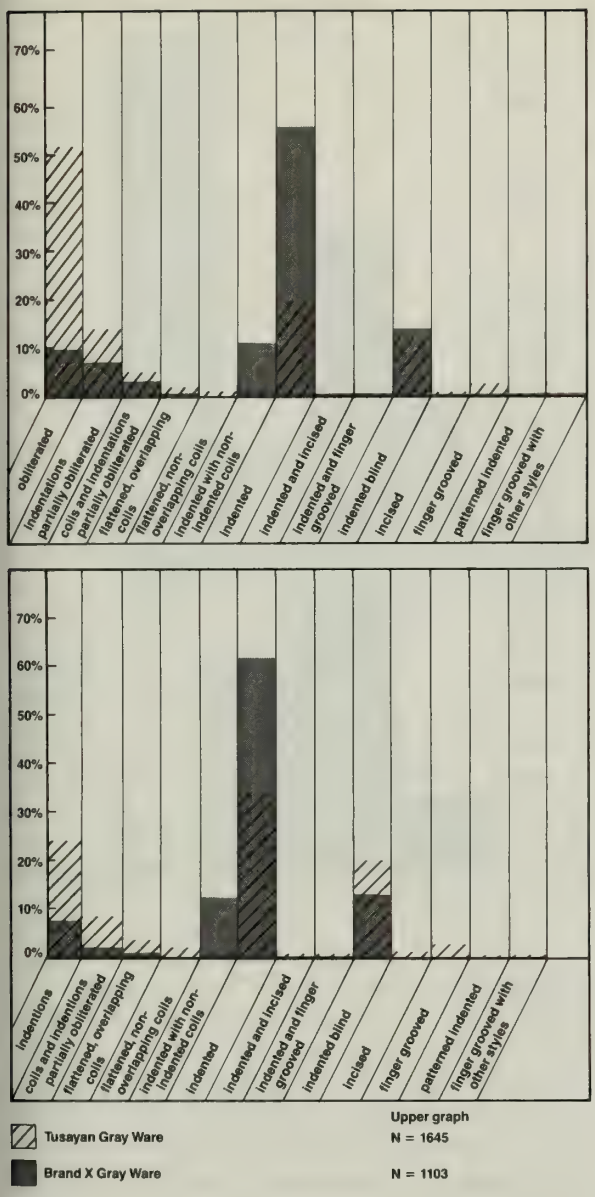


Figure 271. Subtypes of Brand X and Tusayan Gray Wares, including (above) and excluding (below) obliterated subtype.

over indentation, rather than localized indentation, in XGW.

Coil Width (Fig. 272)

Significant differences in coil width between the wares result when data are grouped into classes of small (4 to 7 mm) and large (8 to 11 mm). XGW, with a concentration at 5 to 6 mm, generally has smaller coil widths than does TGW. TGW data are more normally distributed, with the highest frequency at widths of 7 to 8 mm.

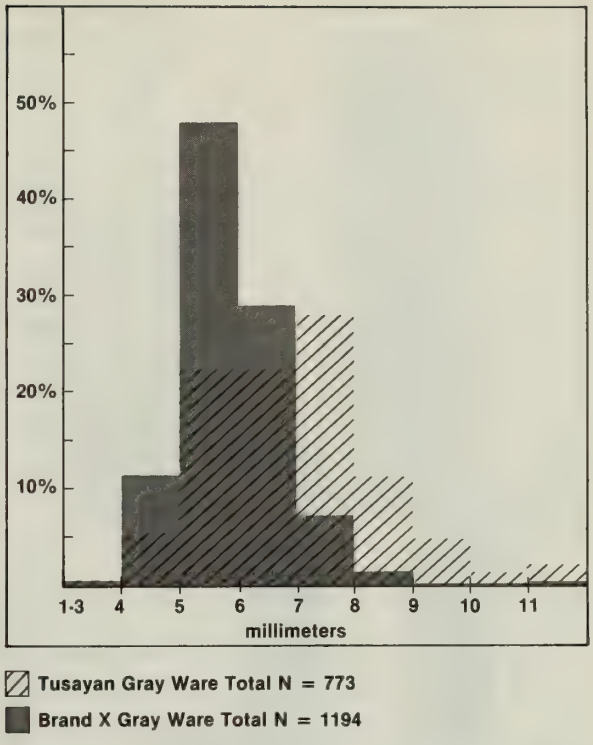


Figure 272. Coil widths in Branch X and Tusayan Gray Wares.

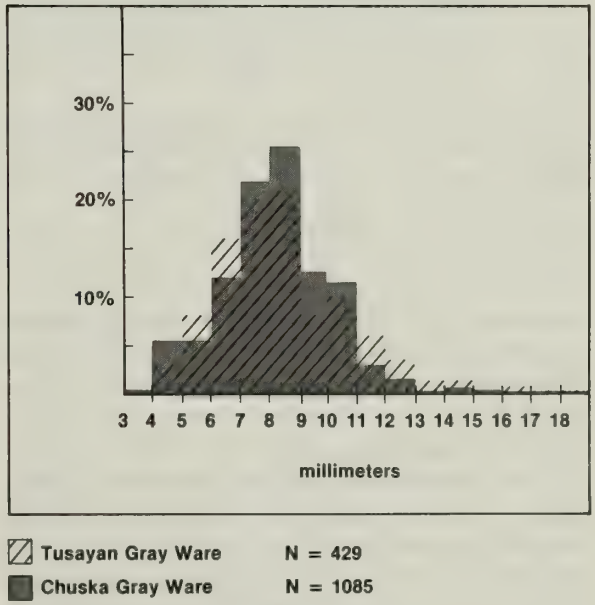


Figure 273. Distance between indentations in Brand X and Tusayan Gray Wares.

Distance Between Indentations (Fig. 273)

The distributions of XGW and TGW on this basis are generally similar. Both have a wide range and fairly normal distribution. The greater

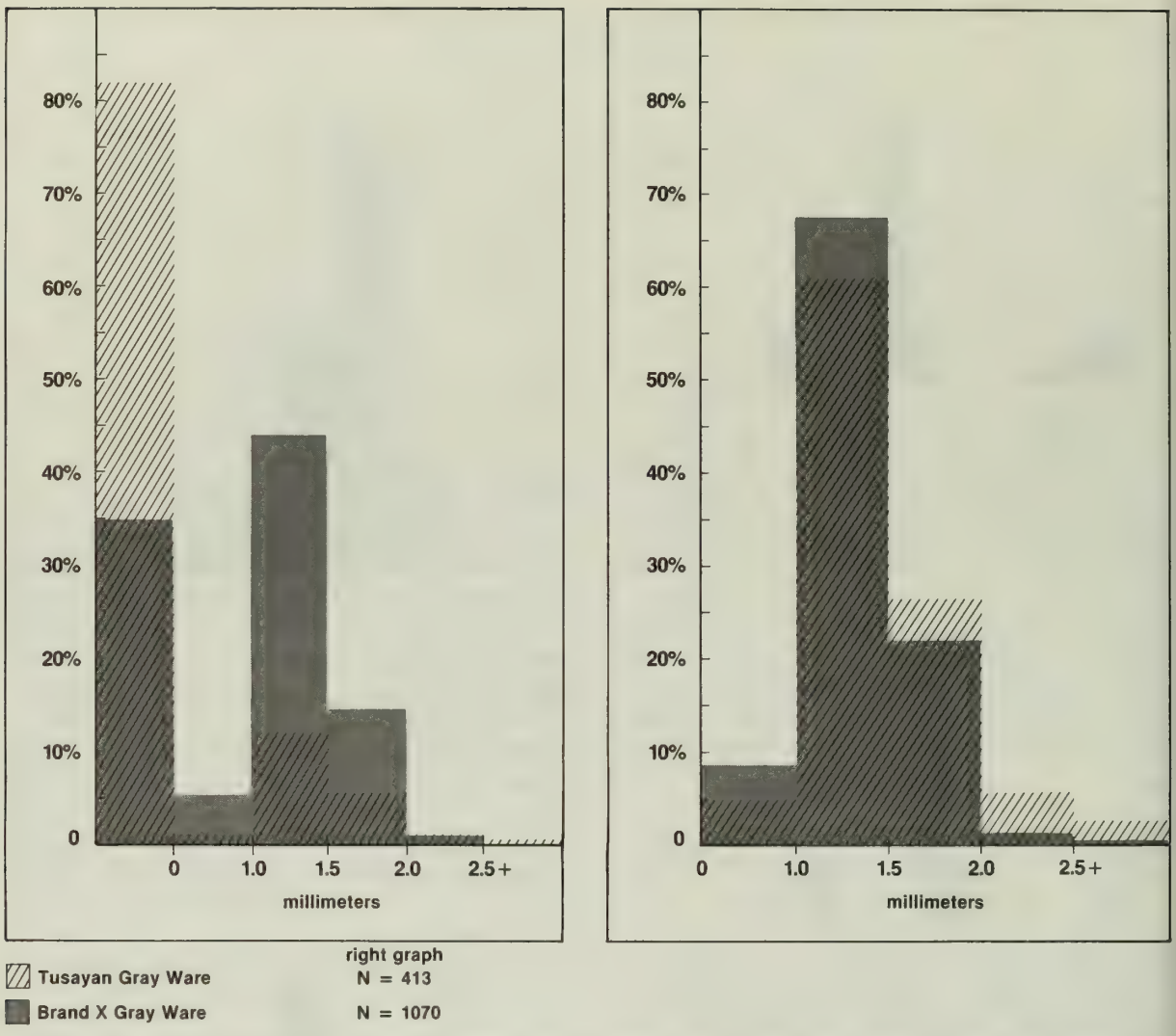


Figure 274. Depths of indentation in Branch X and Tusayan Gray Wares, including (left) and excluding (right) specimens of indeterminate depth.

percentage of TGW in the over 11 mm interval results in a significant level for the χ^2 test using data grouped into 3 mm intervals.

Depth of Indentation (Fig. 274)

For this attribute, and for direction of coiling, there is a much higher percentage of "indeterminate" entries for TGW than for XGW. This probably is related to the greater proportion of TGW obliterated and partially obliterated subtypes on which it is difficult to measure or observe these attributes.

The mean depth of indentation is lower for XGW (2.17 mm) than for TGW (2.39 mm). TGW has a greater percentage of deep indentations (over 2 mm).

Overall Surface Design (Fig. 275)

The major difference in the distribution of the four types of surface design lie in the higher percentage of continuous left for TGW and of overlap for XGW.

Direction of Coiling (Fig. 276)

Almost all of the XGW sherds with identifiable direction of coiling are right coiled. The amount of left coiling, while small (6.4 percent), is significantly greater for TGW than for XGW.

Rim Data

The analyses of rim data are not as limited by small sample sizes as are those of the PII data. However, the total number of sherds with rim

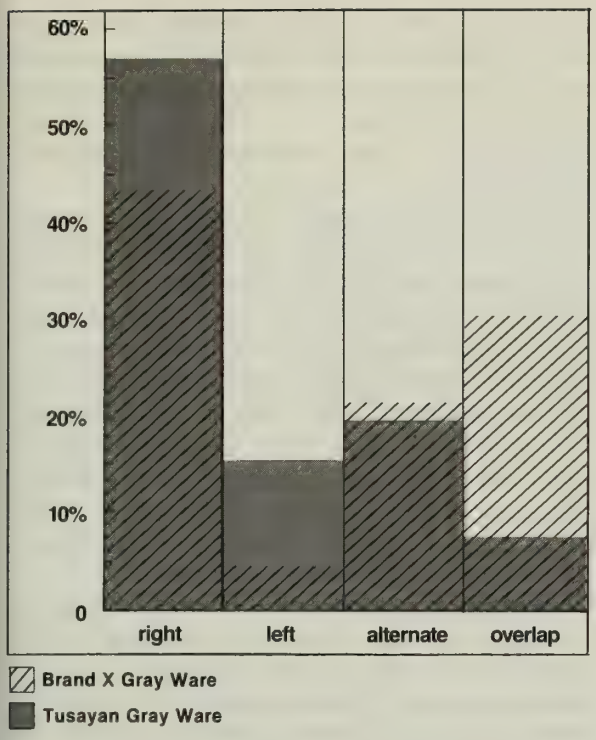


Figure 275. Overall surface design (indentation alignment) in Brand X and Tusayan Gray Wares.

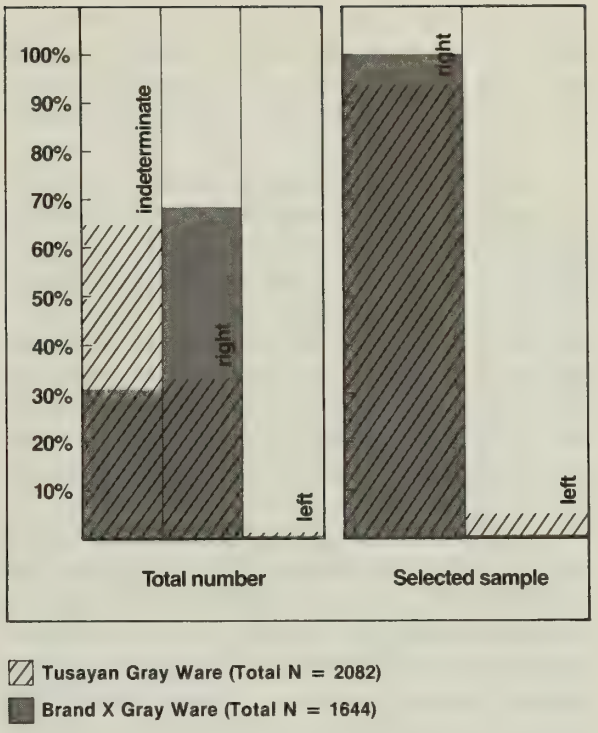


Figure 276. Direction of coiling in Brand X and Tusayan Gray Wares.

information is smaller than the number with the other attributes used in the TGW–XGW comparisons.

Rim Description (Table 185)

Tusayan Gray Ware exhibits a somewhat wider range of rim types than does Brand X Gray Ware. A χ^2 test of the component of the rim type that describes the degree of eversion of the rim (A, B, C, D) indicates a significant association with ware. TGW has a higher frequency of the extremes of straight and everted (A and D) rim types.

Exterior Rim Diameter and Amount of Rim Obliteration (Table 185)

The mean and range of these two variables for XGW and TGW are nearly identical.

Summary

For all but the rim attributes, association with ware greater than would be expected by chance alone is demonstrated for Late PIII. The metrically measured attributes show XGW sherds to have shallower indentations and smaller coil widths on the average than do TGW sherds. XGW also is characterized by the overlap design style and the subtype of indented coils with bands of unindented coils. There is no evidence for greater standardization of traits in XGW, except possibly relating to subtype and coil width.

The Significance of Variability in the Surface Appearance of Utility Sherds

The statistical conclusion to be drawn from this analysis is that the evidence supports rejection of the null hypothesis for both periods. The archeological interpretation is that it is likely that attributes of surface appearance of utility pottery are associated with temper types. In other words, traits other than temper may distinguish the ware categories of utility ceramics.

Colton (1965: 2) includes the general characteristic of surface finish in his ware definitions, but uses the attributes discussed here only to differentiate types within wares. For example, he gives ranges of coil width for Kana'a, Tusayan and other types of Tusayan Gray Ware, but the utility wares are seen as generally similar in shape, size and surface finish. The present study points out detailed differences in surface ap-

pearance that may be helpful in delineating wares. If a ware represents a pottery tradition related to a cultural group, then the attributes shown to be related to a ware reflect the behavior of that cultural group.

Differences in frequency of such attributes as subtype for wares indicate an as yet unknown significance for different methods of altering the surface appearance of pots by manipulations of the coils. Whether such "styles" represent a functional, decorative or other attribute of corrugated vessels is not yet apparent. For example, is a feature such as depth of indentation solely a result of the technical aspects of the manufacturing process, or is it due to the traditional style used by the potter, or both?

A number of archeologists have discussed the origin and development of corrugation and indentation of coils in utility ceramics and the possible reasons for different types or styles. Cushing (1882–83: 492) believed that corrugated pottery evolved in imitation of the earlier boiling baskets, noting similarities in surface appearance of the two. Holmes (1882–83: 278) saw a purely decorative purpose in the different kinds of coil manipulations, as did Hodges (1964: 32): "A very rough and badly formed pot can be made to look much better by breaking up the surface with a mass of impressed pattern." The possibility that corrugated pottery developed as a result of some technical advantage also has been proposed, but not tested. Linne (1965: 35) presents two hypotheses: (1) the corrugations were used to prevent slippage in handling, and (2) indenting the coils served to increase the surface area and allow cooking pots to heat up faster (see also Kidder 1924: 125). The latter could be tested experimentally.

Other nondecorative functions for indented pottery have been proposed. Different styles of indentation may have been used to indicate ownership, as has been found to be the case for decorated vessels (Bunzel 1929: 65). It also has been speculated that types of coiling and indenting may be correlated with the contents of storage vessels. In dark storerooms, the feel of different styles may have been used to identify content (Mike Jacobs 1975: personal communication). Given good preservation of pollen and/or vegetal data, this also is a testable hypothesis.

This brief discussion points out how little is known about the "meaning" behind surface treatment of utility wares. Whether design differences represent behavior related to aesthetics, food preparation activities, preference of groups of individuals or some combination of factors is unresolved. A better understanding of variability in corrugated pottery would result from separation of the decorative and utilitarian components of the attributes. This study assumes that these attributes reflect the meaning that surface treatment of utility vessels had for the prehistoric population. Future research should provide some explanatory laws for the behavior evidenced by

Table 185. Rim descriptions*, Late Pueblo III Brand X Gray Ware and Tusayan Gray Ware sherds.

XGW 93 rim sherds		*TGW* 94 rim sherds	
Degree of eversion:	A = 8	Degree of eversion:	A = 15
	B = 50		B = 37
	C = 30		C = 28
	D = 5		D = 14
	mode = IB3		mode = IC3

Rim Diameter (exterior) (cm)

	Number of Cases	*Mean*	*Range*	*Mode*	*Standardization*
XGW	20	20.95	11 to 28	22	5.62
TGW	22	21.27	12 to 28	20, 22, 24	4.49

Amount of Rim Obliteration (mm)

				Percent of Diameters of:		
	Number of Cases	*Mean*	*Range*	*0–20*	*20–40*	*>40*
XGW	19	25.74	8 to 54	32	63	5
TGW	25	25.60	10 to 45	32	64	4

* See Appendix J.

variation in surface finish. I present below a general discussion of some of the possible explanations for the two cases found at Antelope House.

Functional Variability

It is possible that some difference between wares may be the result of function-dependent attributes. Prehistoric uses of the various sizes, shapes and styles of Anasazi utility ceramics, which may account for some of the variability noted in this study, are not well established. One unmeasured variable, the life span of functional types, will significantly influence the frequency of a type in a given period (see David and Henning 1972: 19). Life span of vessels is an uncontrolled factor in the present analysis.

The presence or absence of sooting, an attribute related to use of a utility vessel, may indicate functional differences between wares. For Late PIII, sample sizes are large enough to investigate this attribute. A χ^2 test shows sooting to be significantly associated with temper type (Table 186). Analysis of specific temper ingredients shows that sherd temper, rather than sherd and sand temper, is the source of this difference. Further tests are needed to determine whether (1) sherd temper is technically superior in some way for cooking vessels, (2) this selection of temper is a nonfunctional preference of the potter, or (3) no actual difference exists (i.e., sampling error).

Metric attributes of surface finish may also be related to vessel size, which presumably has a functional component. Chi-square tests of maximum height, maximum diameter and volume with coil width for whole vessels show no associations significant at d = .05, but sample sizes are small (Table 187). Although not conclusive, these tests do not show that smaller vessels necessarily have smaller coil widths or that larger vessels have larger coil widths. In fact, specific cases to the contrary exist.

Table 186. Sooting on Late Pueblo III Brand X Gray Ware and Tusayan Gray Ware sherds.

Exterior Sooting		*Absent*	*Present*	*TOTAL*
XGW	number	515	549	1064
	percent	48.4	51.6	
TGW	number	848	497	1345
	percent	63.0	37.0	
Sooting		*Absent*	*Present*	
Sherd Temper				
Sand		524	335	
Sand-Sherd		117	44	
Sherd		232	308	
Sherd-Sand		255	224	

Pollen data from Antelope House vessels of different temper types also reveal no definite evidence for differences in vessel use (see Chapter 25). Neither do specific wares appear to be limited to specific features or activity areas. A PII special activity area on Floor 4, Room 21, contains a number of large utility vessels, including both TGW and CGW pots. A similar situation exists in the South Plaza area for Early PIII, where two CGW and four TGW vessels occur together. In the Middle PIII burial (11) in Room 29, a large assemblage of decorated and utility vessels were found, including both XGW and TGW pots. To test in any rigorous manner for functional variation in differently tempered utility vessels, extensive data from floor contact proveniences are required.

Social Groups

Two intrasite social groups are indicated at Antelope House by architectural and vegetal artifact data. Evidence from utility ceramics for North and South Room Block distinctions in Late PIII also is presented in Chapter 24. Some of the variability in attributes of XGW and TGW may be due to separate pottery manufacturing groups living at the site. In PI and PII times, however, occupation was limited to the South Room Block, South Plaza and, to a lesser degree, the Central Room Block. Little can be discerned about social groups or about any possible relationships to utility wares in these earlier periods. Other possible reasons for ceramic variability, therefore, are discussed here: (1) trade of utility wares, (2) indigenous development of new ceramic customs and, (3) migrations into the canyon of groups of people making different wares.

Trade

A good candidate for a trade utility ware is trachyte-tempered Chuska Gray Ware. Early investigations in Chaco Canyon (Hawley 1934; Judd 1954) and recent surveys in the Lower Chaco and Chuska valleys (Peckham and Wilson n.d.; Windes 1977) recognized the occurrence of sherds in this temper in sites far from igneous rock sources.

Windes (1977: 286–290) summarizes the current knowledge of the areal and temporal extent of Chuska Wares. The Chuska Mountains are located just east of Canyon de Chelly, on the New Mexico-Arizona border. As part of the Hopi-Navajo Volcanic Field, they contain numerous sources of trachytic rock and appear to be the area of the local development of Chuska Wares. This pottery has been found in sites to the west of the Chuska Mountains, in the Chinle Valley, but not on Black Mesa or in Tsegi Canyon. North of the San Juan River and in Mesa Verde, very little evidence of Chuska Ware exists. Chaco Canyon is the area of the greatest concentration of trachyte-tempered pottery outside the immediate Chuska area.

In the Chuska Valley and Chacoan sites, the temporal distribution of Chuska pottery appears to be similar. "It occurred sporadically in Late Basketmaker III to Early Pueblo I times and slowly increased through the Pueblo I into the Early Pueblo II period, at which time its numbers increased significantly" (Windes 1977: 289).

Pottery types for decorated Chuska ceramics (both mineral and carbon painted) and for utility ceramics now are established (Warren 1967: 106;

Table 187. Comparison of three measurements and coil width for whole vessels.

Number of vessels *coil width (mm)*	*Maximum Height* (cm) *10–20*	*20–30*	*30–40*	*40–50*
4–5	1	3	4	1
6–7	3	5	9	1
8–9	2	0	2	1
			TOTAL = 32	

Coil Width (mm)	*Maximum Diameter* (cm) *18–28*	*23–38*	*>38*
4–5	6	3	0
6–7	8	9	1
8–9	3	2	0
			TOTAL = 32

Coil Width (mm)	*Volume* (ml) *0–10,000*	*10–20,000*	*20–30,000*
4–5	3	4	1
6–7	8	3	4
8–9	2	2	1
			TOTAL = 28

x^2 Tests

Variables Cross-Classified		x^2	df	P	Reject or Not Reject H_0 at d = .05
Coil Width (mm)	Height (cm)				
4–6, 7–9	10–30, 30–50	2.24	1	.20> P >.10	NR
Coil Width (mm)	Diameter (cm)				
4–5, 6–7, 8–9	18–28, 28–38	.17	1	.95> P >.90	NR
Coil Width (mm)	Volume (ml)				
4–6, 7–9	0–15,000, 15–30,000				NR

Peckham and Wilson n.d.). In the Pueblo Bonito sherds analyzed by Shepard, trachyte used as direct temper is found primarily in organic painted and in utility sherds. In the upper strata of a test trench dated to PII this temper characterizes about 40 percent of all utility wares and 60 percent of all vegetal painted Black-on-white wares (Judd 1954: 183).

Utility vessels traditionally have been assumed to be locally made—that is, of insufficient value to be traded. What is significantly unusual about Chuska Wares is the high volume of trade indicated for utility pottery. For example, in some of the levels in tests made at Pueblo Bonito, more than 85 percent of the utility sherds analyzed are trachyte-tempered (Shepard 1939: 280).

Chuska utility ware is rare at Antelope House; its frequency never approaches that found at Chacoan sites. It was noted earlier that PI to PII is the time of the greatest occurrence of CGW at Antelope House and that in these two periods, it makes up only about 22 percent and 13 percent, respectively, of the total utility sherds sampled. Unlike sites in the Chaco area, the Antelope House CGW assemblage shows a general decrease in frequency from PI on. The early Pueblo period also is the time of the greatest occurrence of Red Mesa Black-on-white, a carbon painted Chacoan ware at Antelope House (see Chapter 21). Decorated sherds at Antelope House were not identified as Chuska Wares, making comparison of the ratio of utility to decorated impossible.

A number of factors are used to indicate trade for a type of pottery. One of these is relative scarcity. Tradewares traditionally are believed to occur in minor quantities. However, this assumption has not been tested, nor has the volume of trade in pottery been measured (Shepard 1968: 353). The foreign tempered CGW from Chacoan sites seem to suggest that the usual views of small quantities of tradewares and of local production of utility vessels do not hold universally.

It also has been suggested that higher value is attached to trade wares than to locally produced wares (see Chapter 21). Frequency of occurrence of repair (a possible measure of value) could not be investigated for CGW versus TGW, since repaired utility sherds from critical proveniences at the site number only 14.

The analyses in this chapter show significant differences in attributes of surface appearance in PII between CGW and the common Antelope House utility ware, TGW. Shepard believes that a great variety and a high development of corrugated pottery is characteristic of a tradeware (Judd 1954: 237). Subjective examination of Antelope House CGW sherds does give an impression of exceptional variety. However, the statistical analysis of attributes shows no definite trend of such skill and experimentation in CGW pottery, nor does it support the opposite, a standardization of attributes.

Finally, there is the question of whether CGW is an "exotic" pottery at Antelope House. In other words, how far from the site is the closest possible source of the trachyte used as temper in CGW? The Chuska Mountain Range is a volcanic chain that contains numerous sites of intrusive and extrusive igneous rock. Fewer locales of the distinctive trachyte used for pottery temper exist. Shepard (1939: 781) suggests a source 80 km distant for the Chuska pottery found at Chaco. This source is on the eastern side of the Chuska Mountains at the foot of Washington Pass, where sites with great quantities of Chuska pottery are located. The western drainages of this area have been suggested as a temper source for de Chelly, as has Beautiful Mountain and terraces along the northern Chaco River for sites to the east of the Chuska Mountains (Windes 1977: 286).

These two drainage areas produce trachyte that is mineralogically distinct. Most notably, Washington Pass trachyte contains olivine and hematite not found in rocks from the Beautiful Mountain area (Warren 1967: 115).

Six CGW sherds from PI to Early PIII proveniences at Antelope House were analyzed petrographically for comparison with published descriptions of the temper in sherds from the Chuska Valley (Warren 1967: 107). This analysis shows the general similarity of the trachyte tempers (see Appendix K). It also reveals no olivine or hematite in the Antelope House sherds, suggesting a source at Beautiful Mountain or elsewhere, rather than at Washington Pass. This small sample of sherds does not provide conclusive evidence for a source of the temper used in the Antelope House CGW, but it indicates an area for further examination.

Little systematic knowledge of the spatial distribution of Chuska wares in de Chelly is available. Examinations of small collections from sites on the plateau near the Spider Rock Overlook, on the south rim of de Chelly, revealed three CGW sherds. Chuska Ware also has been reported for the excavated site of Tse ta'a in Canyon de Chelly (Windes 1977: 290) and for a site on the north rim of del Muerto (Thornton 1976: 16).

Preliminary examination of data from a recent intensive survey in the del Muerto section of the monument (1975–1977) shows 16 of more than 550 sites with at least one identified Chuska sherd (sites recorded prior to this were not necessarily investigated for Chuska Wares). The majority of these 16 sites are dated by ceramics to PII–PIII. Ten of them are on the plateau between the two main branches of the canyon. This may indicate a functional specialization for CGW related to as yet undefined activities carried on at plateau sites.

The survey only sampled the area within the monument boundary (McDonald 1976), so the distribution data for the entire interior plateau are not complete. However, there does seem to be a cluster of sites around Black Rock Canyon, a major tributary of del Muerto, particularly near its head. Eight of the 10 plateau sites with Chuska sherds are located in the Black Rock Canyon area. Black Rock Butte at the head of the canyon is one of the closest sources of intrusive basaltic rock (see Appledorn and Wright 1957: Fig. 1). No tests were done to determine the mineralogical composition of this rock formation (the butte is sacred to the Navajo), but a search for trachytic rocks eroded into the head of the drainage was unproductive.

For de Chelly, then, one interesting problem regarding Chuska pottery is the extent of the suspected trade network. If Chuska Gray Ware vessels are imported, are they brought directly from communities in the Chuska Mountains or by way of Chacoan towns? If a temper source is as close to Antelope House as Black Rock, then much smaller scale trade or even local production of Chuska Gray Ware must be considered. Only specific mineralogical analysis of basaltic rock sources and sherd samples can establish a definite correlation of temper sources and CGW pottery from de Chelly sites. Further analysis by the Canyon del Muerto Survey perhaps will clarify this aspect of the problem.

Finally, the exact nature of the suspected trade of CGW is not defined at present. Trade of temper itself is not probable (Shepard 1968: 337), but whether vessels or contents of vessels were the object of trade is unknown. Shepard (1939: 281), noting the excellence of CGW pottery, believes the pots themselves to have been traded. "An unusual combination of minerals occurring in sanidine basalt-tempered pottery suggests that it may have constituted one of the strongest wares in the Four Corners region" (Windes 1977: 294). However, tests of the strength and porosity of trachyte, sand, and andesitic rock-tempered sherds did not conclusively show association of one temper type with stronger or less porous vessels. The mineral content of the clay appears to have a greater effect on these traits (Windes 1977: 294–297). In any event, the product or services likely to be exchanged in this trade need to be determined.

Studies of the time-space distribution and further detailed attribute analysis of Chuska Wares are essential to an understanding of the stylistic and technical differences between wares noted in this study. The Chuskan problem, as it has been called, holds potential for explaining the interactions of the Antelope House population with areas outside the canyon. The place of utility pottery in the economy of a number of Anasazi populations could also be defined through studies using this easily identified and intensively distributed ware.

Migration vs. Indigenous Development

The situation with regard to Late PIII utility ceramics at Antelope House is less clearly related to a certain type of behavior, but some aspects of the ceramic data point to movement of peoples into the site. In the Late PIII decorated sherd collection, the percentage of sand-tempered Kayenta pottery decreases dramatically and that of sherd-tempered Mesa Verde Black-on-white pottery increases sharply (see Chapter 21). The traditional Mesa Verde Gray Ware contains crushed igneous rock (mostly andesite or diorite) (Breternitz *et al.* 1974). This ware is extremely scarce at Antelope House; instead, the utility ware that appears in large quantities in Late PIII is sherd-tempered (Brand X Gray Ware).

A Late PIII migration into de Chelly of people of the cultural tradition found to the north and east has been suggested (see Chapter 21; McDonald 1976). Examples of distinctive Mesa Verdean architecture in Late PIII sites in the canyon, such as Mummy Cave, tend to support this suggestion. At Antelope House itself, however, no clearly Mesa Verdean architecture is present.

Establishing the fact of population movements with ceramic evidence has been notoriously difficult. It is not easy for the archeologist to separate components of migration, indigenous development and copying of local and traded wares. The variables conditioning change in pottery traditions—acceptance or rejection of traits and a conservative versus innovative attitude—remain unspecified, particularly for utility ceramics. No conclusive tests explain the cause of the Late PIII situation at Antelope House, but some possibilities can be discussed.

Shepard (1968: 339) suggests that the proportion of a suspected intrusive ware at a site may help determine whether it was made by immigrant groups. If migration occurred, there would not be a diversity of foreign ceramics but a high percentage of one kind of intrusive pottery. Brand X Gray Ware constitutes 44 percent of the utility sherds dated to Late PIII at Antelope House. Other probable nonlocal types are limited to very small percentages of Chuska Gray and Little Colorado Gray Wares. In Late PIII, Tusayan Gray Ware decreases in frequency but still accounts for 49 percent of the sherds. These proportions could result from the immigration of a new group of people into part of the site. However, trade cannot be ruled out as a possibility, since CGW occurring in similarly high percentages at Chacoan sites shows evidence of being a tradeware. There could be intracanyon trade between Antelope House and sites with evidence of Mesa Verde influence, such as Mummy Cave.

Significant differences between the surface appearances of XGW and TGW sherds illustrated in this chapter suggest the operation of different stylistic traditions. The temper of XGW, however, is not of an obviously foreign nature (although mineralogical analysis of the paste could reveal "exotic" elements). If migration from the Mesa Verde area occurred, the new occupants of Antelope House would have lacked the rock sources traditionally used for their utility ware. They may have switched to sherd as a tempering material, since its use in their decorated wares was already established. In the Lower Chaco River survey, sherd-tempered utility pottery was found in association with Mesa Verde Black-on-white pottery at PIII sites (Windes 1977: 329). On the other hand, by late PIII, sherds certainly were a very accessible material for temper and local adoption of it is highly possible. Technically, sherd temper makes for stronger pots than do sand or rock temper by forming stronger bonds with clay (Shepard 1968: 27). An awareness of this by prehistoric potters may have influenced their choice of temper for Brand X Gray Ware. Comparative data from detailed analyses of utility pottery from Mesa Verde and de Chelly sites is essential if one is to go beyond speculation about this problem.

Suggestions for Future Research

In this investigation of Antelope House utility pottery, significant associations of attributes of style and technique of manufacture with temper type are found for CGW versus TGW in PI and PII and for XGW versus TGW in Late PIII. Subjective consideration of the behavior represented by these differences tentatively suggests trade as a mechanism for the occurrence of CGW and, even more tentatively, movement of peoples for the occurrence of XGW. The primary aim in this study is to provide an example of making use of the information contained in utility ceramics. This analysis reveals the potential of this artifact class for understanding prehistoric economic behavior, and points to the need for an explanation of variability in utility ceramics. The following are suggestions for orienting research in this regard.

Rigorous tests of variability could be done by eliminating some of the limitations of the present study and by testing some of its assumptions. Sampling and attribute analysis should be developed specifically for the test being undertaken. Whole vessels from floor proveniences would provide ideal data to begin to clarify the nature of utility ceramic differences. Once useful attributes are thus determined, sherd analysis would be more valid. Multivariate analysis of attribute data would provide a comprehensive picture of differences in "style," as well as indicate important relationships among variables.

Once the variability in utility ceramics has been specified, tests to eliminate or support possible causes of it can be begun. Function, social

organization and trade are likely candidates. Technical studies, especially those focusing on the qualities of strength, durability and conduction of heat of different temper types, will help define functional aspects of temper selection. Windes' (1977) tests of the strength and porosity of sherds indicate the need for study of the effect of differing clays on the technical attributes of utility pottery. Ethnographic studies concerned with material culture provide another line of investigation. Determination of the effects produced by differing life spans of vessels and discard patterns, as begun by David and Hennig (1976) and Foster (1960), can identify at least the range of possible causes of ceramic variability.

To understand the situation at Antelope House, a more detailed picture of temporal changes and of outside interactions for the canyon as a whole needs to be developed. The Canyon del Muerto survey is in a position to attempt to refine the time and space distribution of temper types. For CGW, this would be fairly easy, since this temper is readily identified in the field. Systematic investigations of temper sources also would be profitable. The status of Brand X Gray Ware and de Chelly-Mesa Verde interactions are less easily tested without intensive study of changes in artifactual and architectural data.

Most crucially, future research needs to focus on relating utility pottery data to other lines of evidence for prehistoric behavior. We must always be cautious not to confuse ceramics with cultural groups, but the potential of analysis of utility ceramics for understanding behavior of past cultural groups is obvious. Utility vessels presumably played a vital role in the economy of the occupants of a site and should not be ignored as a source of understanding aspects of that economy.

Chapter 24

The Utility Pottery: Behavior and Organization Studies

During the past decade, the problems involved in delineating social unit relationships within prehistoric communities on the basic of ceramic interpretations have been extensively debated. A key issue has been the validity of making inferences about descent and residence (Allen and Richardson 1971; Bartovik 1974).

The utility ceramics section of the Antelope House research design was developed as a method of testing social group differences on the basis of ceramic interpretations. The analysis was directed by the hypothesis that there were different social units related to the division of Antelope House into separate and distinct room block areas. There are three aspects of the analysis which differ from many previous studies of this topic: (1) the data are acquired from utility ceramic materials, (2) the social group differences are defined by activity group participation, rather than by descent and residence constructs, and (3) the ceramics are analyzed with respect to manufacturing and design variability, with the spatial distributions of certain attributes being interpreted in terms of behavior and organization. This means that the study does not rely solely on design styles, but also makes observations on construction techniques and materials used. In focusing on the aspects of social group differentiation, one takes the controversial step of reconstructing social structure from archeological remains.

Many past studies using ceramic materials have attempted to infer descent and residence relations for the spatial units detected (Deetz 1965; Longacre 1970), but the validity of such reconstructions has been questioned by Allen and Richardson (1971). Their argument, based on studies of residence and descent theory and on examples from the ethnographic literature, is that the analysis of kinship is best left to the ethnographer, unless extremely detailed historical data are available. Due to major controversies about residence theory, they argue, the interpretation of extant residence patterns is extremely difficult, and so the interpretation of residence patterns for extinct societies based solely on archeological remains is even more questionable. They acknowledge, however, that groupings may be detected:

> While it is clear that archeologists are unable to discern the residence choices of individuals, it would appear that observable aggregates are recoverable from the material remains of extinct cultures (1971: 50).

I employ the concept of social unit of activity, since it allows for the description of variation between functionally equivalent units indicative of activities performed by different social groups (Freeman 1968). It avoids the problem of interposing constructs of residence and descent to explain the presence of social groups distinguished on the basis of ceramic variability. Deetz (1972) has stated that the categories devised by ethnologists to describe the cultural universe which they study should not be categories with which the archeologists seek correspondence in their data. He feels that if this proposition is valid, then a largely ignored task before the archeologist is the delineation of the nature of the relationships between behavioral and material categories, without interposed constructs such as residence, descent or exogamy.

This discussion suggests that social groups need not be characterized by residence or descent constructs in order to detect social structure

relationships. Participation by these groups in these relationships is not necessary for their recognition. As Rohn has stated:

> Persons who live together—in the same house or in the same community—may do so primarily because of kin or marriage relationships, or because of other factors, such as common language, but their very living together involves the sharing of space, facilities, resources and activity. It is this sharing of material goods and the cooperation involved in the satisfying of needs and wants of all the individuals concerned that may be reflected in the archeological remains (1965: 65).

Thus he argues that the prehistorian may discern traces of socioeconomic groups; that is, their cohesion probably rests on sociological factors, but their recognition by the archeologist depends on cooperative economic behavior. An example of this behavior may be reflected by ceramic variation resulting from discard activities.

Research Design

The objective of the analysis is to discover the spatial boundaries of the recurrent activities related to ceramic discard behavior and relate this to the population present at Antelope House during Late Pueblo III. Toward the solution of this problem, this study is structured to test the variation in construction and finishing techniques and materials of the ceramic products and to correlate this to their distribution as a result of the discard behavior of the population. The concept of social unit of activity (Freeman 1968) will be used to interpret the interrelations between the behavioral and spatial material aspects of these ceramic discard activities. This is simply a social unit which consists of all people associated with the specific activity. While these groups may coincide with residence groups, it is not assumed so; it is the responsibility of the investigator to indicate their relationship to the community.

If different discard areas are discovered, these are to be compared with the loci of use and discard areas of other artifacts categories. Interpretations may then be made as to the nature of various activity groups present at Antelope House.

The analysis necessitates a procedure for typology which deviates from the traditional Southwestern typological system, due to my emphasis on the differentiation of construction and finishing techniques. Within the traditional system, attribute selection is regulated by a problem orientation focused on building chronologies and defining culture areas (Colton 1955). Deetz (1972) describes this approach by stating that traditional archeological description has been based on the "type" concept, in which artifacts are classified according to their formal similarities and assemblages are compared largely in terms of sherd types. The artifiact type is an arbitrary category based on similarities in characteristics selected by the classifier from a much larger range of characteristics. As such, it has been useful tool in deriving relatively coarsegrained groupings which, when compared, permit rather general statements of relationships between archeological cultures in time and space.

The traditional approach, however, does not provide the data necessary to answer questions about activities and behavioral systems at the intrasite level. Variation within types is obscured, hampering studies directed toward the detection of separate, but functionally equivalent, contemporaneous activity areas within a community boundary. Hill and Evans, with regard to the subject of typologies and the development of multiple research problems, state:

> It is important to recognize that the standard types are not *the* types in any fundamental sense, and should not be viewed as such, even unconsciously. The recent development in archeology of a multiplicity of different kinds of research problems has made it necessary to begin emphasizing the idea that types can also be 'multiple,' and can be constructed to be useful in solving a multiplicity of research problems. . . . our problems have until recently been restricted (usually) to the space-time systematics, or to culture-history (1974: 249).

It can be seen that the kind of typological system used depends on the problem orientation one has taken.

The investigator needs to create what is in effect a typology of attributes and then consider the data in terms of the manner in which these attributes combine and recombine in response to the culture producing them. It is at the level of the discrete attribute that patterning of the type which represents specific non-material aspects of the culture becomes evident (Deetz 1972: 113).

The typological system developed for the analysis of Antelope House utility ceramics organized data relevant to the analysis of construction techniques, materials and stylistic differentiation and will reveal ceramic product differences resulting from these manufacturing activities if they occur.

Hypotheses

The structure of the archeological record requires that a fundamental transformation be made in order to test the proposition that the location of different social groups may be correlated to differential discard behavior. Transformation concepts and operations function as existence and relational statements, allowing one to model systematically the cultural and environmental processes responsible for the formation of the archeological record (Reid 1973: 25). Testing for separate ceramic discard groups within the Antelope House community requires that a transformation be made from a concept meaningful in terms of behavior (discard areas) to those attributes observed in the archeological context (construction and finishing techniques and materials). To produce this transformation, it is argued that the delineation of differential discard areas requires that ceramic attributes exhibit a nonrandom patterning. This test follows from a general research goal (see Chapter 5) pertaining to the detection of social units within the Antelope House community.

The discussion of this transformation relationship may be stated as a specific hypothesis about discard behavior:

Hypothesis la—If differential discard areas occur within the site, this will be revealed by nonrandom patterning of specific ceramic attributes related to construction and finishing techniques and materials.

Hypothesis 1b—The null hypothesis of no association.

An important assumption for all analysis made of Antelope House materials is that the groups hypothesized to be associated with the separate room block areas tended to deposit their trash and other materials near their habitations, so that trash and architecture are representative of the same group.

Test Implications

The generation of test implications for this hypothesis requires that manufacturing differences be transformed into empirically measurable and observable ceramic attributes. Eight attributes, incorporating observations of materials, construction techniques and stylistic finishing techniques, are used to measure these manufacturing differences. These attributes include tempering materials, overall surface styles, coil direction and widths, indentation angle directions, depths, distances between the angles and the resulting indentation patterns. The attributes are broken down into intervals in order to obtain data on distributional variation. All attributes are expected to occur throughout site areas; however, differential distribution of the interval data may occur (Table 188).

If the hypothesis is correct, the following test implications should reveal the proposed variability in discard areas within the Late PIII Antelope House community:

1. Different discard areas should be represented by significantly different frequencies of some or all construction technique attribute intervals.

2. Different discard areas should be represented by significantly different frequencies of tempering material selection.

3. Different discard areas should be represented by significantly different frequencies of coiling and indentation interval data as a result of differential stylistic manipulation.

Limitations

Before proceeding with a discussion of the analysis, it is appropriate to discuss two factors that imposed limitations or caused some difficulty with the analysis.

The first of the difficulties is temporal. Excavation at the southern end of the site revealed that occupation in that area spanned the Basketmaker III through Pueblo III periods. However, excavation in the northern portion of the site showed that there was no Pueblo II occupation. There is a limited amount of earlier artifactual material from the Basketmaker III and Pueblo I periods. As a result, social structure reconstructions must be limited to Pueblo III. Because most of the ceramic material in PII de-

Table 188. Utility pottery variables, broken down into attribute intervals.

Temper:
sand (144)
sherd-sand (314)
sherd (344)
Subtypes:
#1—obliterated
#2—Moenkopi style
#3—Moenkopi style—coils and indentations nearly obliterated
#4—Kana's style—overlapping coils
#5—Kana's style—non-overlapping
#6—indented corrugated + small bands of plain coils
#7—indented corrugated
#8—indented corrugated + incising
#9—indented corrugated + finger grooving
#10—blind indented
#11—incising variations
#12—finger-grooving variations
Coil direction:
#1—counterclockwise
#2—clockwise
Coil Width:
#1— 3 mm
#2— 4 mm
#3— 5 mm
#4 6 mm
#5— 7 mm
#6— 8 mm
#7— 9–14 mm
Distance:
#1— 3–5 mm
#2— 6 mm
#3— 7 mm
#4— 8 mm
#5— 9 mm
#6—10 mm
#7—11–12 mm
#8—13–18 mm
Depth:
#1—0.1–0.9 mm
#2—1.0–1.1 mm
#3—1.2–1.3 mm
#4—1.4–1.5 mm
#5—1.6–1.9 mm
#6—2.0–5.0 mm
Angle:
#1—indeterminate
#2—diagonal right
#3—diagonal left
#4—vertical
#5—combination
#6—direct pressure
Surface Design:
#1—indeterminate
#2—continuous right
#3—continuous left
#4—alternate
#5—combination
#6—overlap

posits is secondary refuse, it would not be realistic to perform distributional studies solely within the South Room Block, where the PII remains are found. Therefore, specifically for this analysis, only the Late Pueblo III period (AD 1200–1300) is tested. Temporal control for the range of this period is firm, based on tree-ring, archeomagnetic and ceramic dating.

The second factor is the large amount of material recovered (72,647 utility sherds) and the limited amount of time for analysis. Because of the detailed analysis necessary to extract the data appropriate for testing the social unit hypothesis, only Late PIII floor contact proveniences in the room block areas are used in this analysis. This amounts to 2668 sherds, or 82 percent of the total Late PIII assemblage (corrugated only). An attempt was made to represent the variety of vessels made by the different Antelope House potters in Late PIII by counting each only once. This, of course, is not entirely feasible, but an attempt was made to avoid duplication where possible. Therefore, if 10 sherds were determined to be from the same vessel, they were recorded on one

ceramic computer form, and in the count space on the form, a 10 was recorded. This form then was punched 10 times, providing the frequency data used in the descriptive section. For this analysis, however, we wished to represent only the variety of vessels present—hence, the variety of manufacturing techniques—without stressing situations in which some vessels were represented by high sherd counts and others by low counts, as the vessels with high counts would skew the analysis by overrepresenting those techniques. All computer forms, therefore, were counted only once and the numerical designation in the count space was deleted for the social unit analysis. The resulting count employed for analysis is 1717 sherds, or 53 percent of the total Late PIII assemblage of corrugated utility ceramics.

Hypothesis Test

After preliminarly classification and typological procedures, the frequencies of the attributes were cross tabulated with the spatial unit of analysis, the room block and plaza areas of the site. The cross tabulation of these attibute intervals with the partitioned site areas revealed that differences in the distribution of intervals are present (Appendix I). Contingency tables, based on the frequency distribution of the intervals established for each attribute, were formulated to test these observations of differential patterning. The acceptable level of significance used for the analysis is a probability of .05 or less. Chi-square calculations were applied to each attribute matrix, with the resulting values indicating significant associations between room blocks and attributes at the probability level of .05 or less (Table 189). The formula used for these calculations is:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - e_i)^2}{E_i}$$

where O_i = observed frequency
where E_i = expected frequency

Within the interval range established for each attribute, significant chi-square values for selected intervals indicate differential associations with specific room blocks.

The variation within the tempering ingredients indicates that the sand ingredient occurs significantly below the expected frequency in the South Room Block and above it in the other two room blocks. The opposite occurs for the sherd-sand combination, however, as the South Room Block significantly exceeds the expected and the North and Central Room Blocks exhibit frequencies far below those expected. These chi-square values are presented in Table 190. Differential associations of attribute intervals and room blocks indicate consistent variation in construction techniques and preferences. The attribute—angle of indentation—includes two intervals which exhibit significant differences between room blocks. Diagonal left indentations (Interval 3) occur less frequently than expected in the South Room Block, but more frequently than expected in the north. Vertical indentations (Interval 4) occur less frequently than expected in both the North and South Room Blocks and significantly exceed the expected frequency in the central area. These calculations are presented in Table 191.

Table 189. Chi-square values of variables.

Temper:	
89.20	$p < .01$ @ 4 df
Subtypes:	
223.7	$p < .01$ @ 22 df
Angle:	
27.12	$p < .01$ @ 6 df
Surface design:	
31.34	$p < .01$ @ 8 df
Coil direction:	
8.59	$p < .02$ @ 2 df
Coil width:	
43.29	$p < .01$ @ 10 df
Depth:	
78.89	$p < .01$ @ 10 df
Distance:	
33.39	$p < .01$ @ 14 df

Variation in the stylistic attribute of surface design (Table 192) indicates that Interval 2, the continuous right indentation pattern, occurs more frequently than expected in the North Room Block, at the expected frequency in the central, and below the expected frequency in the south. The irregular pattern (Interval 5) occurs more often than expected in the south and less often than expected in the other two areas. The overlap pattern (Interval 6) occurs more frequently in the central, less frequently in the south, and at the expected frequency in the north.

Coil direction (Table 193) falls significantly short of the expected frequency in the clockwise direction for the South Room Block, but this most likely is due to the small sample in that cell. Some intervals for depths of indentation indicate variation from the expected (Table 194). Depths

Table 190. Chi-square values of temper ingredient and frequency distribution of attribute by room block.

		S		*C*		*N*
Sand	E	273.98	E	233.39	E	250.6
(144)	0	209	0	268	0	281
	X^2	15.41	X^2	5.13	X^2	3.69
Sherd-sand	E	170.27	E	145.05	E	155.74
(314)	0	252	0	110	0	109
	X^2	39.23	X^2	8.47	X^2	14.03
Sherd	E	176.73	E	150.55	E	161.65
(344)	0	160	0	151	0	178
	X^2	1.58	X^2	1.35×10^{-3}		
	X^2	1.64				

$X^2 = 89.20$ @ 4 df

Table 191. Chi-square values of angle of indentation and frequency distribution of attribute by room block.

		S	*C*	*N*
2. Diagonal right	E	339.15	207.48	251.37
	0	358	188	252
	X^2	1.05	1.83	.0016
3. Diagonal left	E	12.33	7.54	9.14
	0	3	11	15
	X^2	7.06	1.59	3.76
4. Vertical	E	52.70	32.24	39.06
	0	43	49	32
	X^2	1.79	8.71	1.28
5. Combination	E	20.83	12.74	15.44
	0	21	12	16
	X^2	.0014	.04	.02

$X^2 = 27.12$ @ 6 df

Table 192. Chi-square values of surface design patterns resulting from indentation combination and frequency distribution of attribute by room block.

		S	*C*	*N*
2. Continuous right	0	26	20	38
	E	34.22	21.90	27.89
	X^2	1.97	.16	3.66
3. Continuous left	0	2	7	7
	E	6.52	4.17	5.31
	X^2	3.13	1.92	.54
4. Alternate	0	9	11	11
	E	12.62	8.08	10.29
	X^2	1.04	1.06	.05
5. Irregular	0	155	72	96
	E	131.56	84.20	107.22
	X^2	4.18	1.77	1.17
6. Overlap	0	8	18	11
	E	15.08	9.65	12.29
	X^2	3.32	7.23	.14

$X^2 = 31.34$ @ 8 df

Table 193. Chi-square values of coil direction and frequency distribution of attribute by room block.

		S	*C*	*N*
1. Counter-clockwise	0	423	233	286
	E	416.29	236.48	289.25
	X^2	.11	.05	.04
2. Clockwise	0	3	9	10
	E	9.71	5.52	6.75
	X^2	4.64	2.19	1.56

$X^2 = 8.59$ @ 2 df

Table 194. Chi-square values for depths of indentation and frequency distribution of attribute by room block.

		S	*C*	*N*
.1– .9 mm	0	36	21	32
	E	38.30	21.65	29.08
	X^2	.14	.02	.29
1.0–1.1 mm	0	136	65	56
	E	110.54	62.48	83.94
	X^2	5.86	.10	9.30
1.2–1.3 mm	0	96	44	47
	E	80.45	45.47	61.10
	X^2	3.01	.05	3.25
1.4–1.5 mm	0	58	32	53
	E	61.51	34.77	46.71
	X^2	.20	.22	.85
1.6–1.9 mm	0	17	21	61
	E	42.57	24.06	32.33
	X^2	15.36	.39	25.42
2.0–5.0 mm	0	2	12	13
	E	11.63	6.57	8.83
	X^2	7.97	4.49	1.97

$X^2 = 78.89$ @ 10 df

from 1 to 1.1 mm significantly exceed the expected in the South Room Block and fall short in the north. Depths from 1.6 to 1.9 mm are significantly below the expected in the south and above it in the North Room Block. Depths greater than 2 mm significantly exceed the expected in the central area. Coil widths (Table 195) significantly exceed the expected in the South Room Block at the 5 mm interval and in the North Room Block at the 6 mm interval. There is one significant value for distance between indentations (Table 196): the 6 mm interval exceeds the expected frequency in the central area.

Variation in subtype styles (Table 197) indicate that many of the chi-square values show significant differences from the expected frequency. Interval 1 occurs significantly above the expected in the North Room Block and shows a corresponding deficit in the south. Interval 4 exceeds the expected frequency in the central area and falls short in the south. Interval 6 exceeds the expected frequency in the South Room Block

Table 195. Chi-square values of coil widths and frequency distribution of attribute by room block.

Coil Width		*S*	*C*	*N*
3– 4 mm	0	72	40	42
	E	62.42	43.69	47.95
	X^2	1.47	.31	.74
5 mm	0	199	95	104
	E	161.27	112.85	123.89
	X^2	8.83	2.82	3.19
6	0	86	92	110
	E	116.69	81.66	89.64
	X^2	8.07	1.31	4.62
7 mm	0	62	49	55
	E	67.27	47.07	51.68
	X^2	.41	.08	.21
8 mm	0	26	22	18
	E	26.73	18.70	20.53
	X^2	.02	.58	.31
9–14 mm	0	8	19	19
	E	18.66	13.06	14.34
	X^2	6.09	2.70	1.51

$X^2 = 43.89$ @ 10 df

and falls short in the north. Interval 7 exceeds the expected in the south and falls short in the central area. Interval 10 exceeds the expected level in the north and falls short in both the south and central areas.

Conclusions

Several points become clear as a result of this analysis. First, the feasibility of employing manufacturing attributes of utility ceramics as a framework for differentiating social units related to ceramic discard activities is supported. Secondly, all attributes selected for this analysis are suggested to be useful for testing the proposition that differential discard areas are reflected by variable aspects of ceramic manufacturing techniques. An analysis employing these attributes and applied to primary refuse ceramic data could reveal much about social aspects of the population using or producing this pottery. The analysis could then focus on different use areas and possibly define separate areas of manufacture.

A third point arising from the analysis concerns the patterning within the ceramic system as a result of differential discard behavior. The chi-square analysis reveals significant differential associations of specific attribute intervals with separate room block areas. The interpretations made from this analysis suggest that patterning represents different discard areas related to socially separate habitation locations. One discard area is associated with the South Room Block, another with the Central Room Block, and a third with the North Room Block.

Additional tests with other independent data should be analyzed in order to evaluate the credibility of the conclusions of the ceramics analysis. This follows from a belief that one occurrence of a pattern could be due to chance, but that similar patterns in several independent data categories provide more conclusive evidence of past behavior.

Morris's architectural analysis (Chapter 7) notes several features which differentiate the north and south ends of the site. He splits the central area in half, associating the northern portion with the North Room Block and the southern portion with the South Room Block. He interpretation is that as rooms were phased out in the North Room Block in Late PIII, the people moved into the central area, but remained associated with the north. The architectural styles of the two areas are similar. The southern end of the central area is composed almost exclusively of storage rooms and Morris associates these architecturally with the South Room Block. The two major north-south areas are determined to be functionally equivalent, with the differences attributed to different contemporaneous groups of masons.

Table 196. Chi-square values of distances between indentations and frequency distribution of attribute by room block.

		S	C	N
3– 5 mm	O	26	23	33
	E	35.08	21.32	25.58
	X^2	2.35	.13	2.15
6 mm	O	39	45	31
	E	49.2	29.9	35.88
	X^2	2.11	7.63	.66
7 mm	O	79	42	40
	E	68.89	41.87	50.24
	X^2	1.48	.0004	2.09
8 mm	O	94	44	60
	E	84.71	51.48	61.78
	X^2	1.02	1.09	.05
9 mm	O	54	25	31
	E	47.06	28.6	34.32
	X^2	1.02	.45	.32
10 mm	O	41	16	32
	E	38.08	23.14	27.77
	X	.22	2.20	.64
11 mm	O	17	9	18
	E	18.82	11.44	13.73
	X	.18	.52	1.33
12–18 mm	O	12	16	19
	E	20.09	12.21	14.65
	X	3.26	1.18	1.29

X^2 = 33.39 @ 14 df

Table 197. Chi-square values of subtype styles and frequency distribution of attribute by room block.

Subtype		S	C	N
1	E	44.38	36.07	40.53
	O	23	79	19
	X^2	10.29	51.09	11.43
2	E	84.36	68.56	77.05
	O	78	62	90
	X^2	.47	.62	2.17
3	E	27.84	22.62	25.42
	O	33	29	19
	X^2	.95	1.79	5.13
4	E	14.98	12.18	13.68
	O	4	26	11
	X^2	8.04	15.68	.52
5	E	5.81	4.72	5.31
	O	2	8	6
	X^2	2.49	2.27	.08
6	E	44.38	36.06	40.53
	O	71	35	15
	X^2	15.96	.03	16.08
7	E	311.43	253.1	284.43
	O	356	212	281
	X^2	6.37	6.67	.04
8	E	.71	.57	.64
	O	0	1	1
	X^2	.71	.18	.2
9	E	2.19	1.78	2
	O	1	1	4
	X^2	.64	.34	2.00
10	E	95.34	77.49	87.08
	O	71	59	130
	X^2	6.21	4.41	21.15
11	E	3.61	2.94	3.3
	O	2	4	4
	X^2	.71	.38	.14
12	E	10.59	8.61	9.67
	O	5	9	15
	X^2	2.95	.01	2.93

X^2 = 201.13 @ 22 df

Analysis of the basketry industry at Antelope House indicates that variations in the coiling and plaiting components of the assemblage are nonrandomly distributed within the community. Adovasio and Gunn (Chapter 20) state:

> It would appear that several distinct groups of weavers were operating simultaneously at Antelope House, at least during Late PIII. Moreover, it seems that these groups may be linked to specific residential units of the site.

The results of analysis of *Zea* remains again support the suggestion of dual social groups within the Late Pueblo III community. Based on his analysis of percent of row count on cobs, Hall (Chapter 11) concludes that at least two social groups are represented, one in the North Room Block and the other in the South Room Block. His interpretation is that these groups were selecting for the growing different maize types.

The studies of these different data categories indicate the presence of at least two activity groups associated with each assemblage. Assuming partitioning of an activity set into two or more separate loci representing similar activities carried out by different groups, slight differences may occur in discard materials.

The three differential attribute areas indicated for the utility ceramics analysis suggest separate discard locations associated with different social units of activity. These three activity grops are seen as associated with two larger social units, which comprise the community population. Admittedly, this pattern is tentative if based on the ceramic evidence alone. When combined with the studies mentioned above, however, credibility is given to the proposition of two basic separate areas within the site associated with these different social units. The third ce-

ramic activity group, associated with the north-central area, is interpreted as an extension of the North Room Block group, an occurrence also noted by Morris in the architectural analysis. Many of the frequency counts for expected and observed values in the contingency tables fluctuate in the same manner for the north and central areas, as opposed to the South Room Block. The results of my analysis, when compared with other organization studies on Antelope House materials, suggest that during Late Pueblo III, two separate social groups comprised the community at Antelope House.

What this discussion is meant to point out, and what the analysis supports, is that reconstruction of social group distributions is possible from the study of prehistoric ceramic materials. Furthermore, this is possible without relying on kinship and residence constructs to explain the patterns. Cooperative behavior within each of the different social groups of an extinct community offers a good chance that the physical remains used or produced by such groups will reflect minor differences in discard locations. This is suggested to have occurred at Antelope House during Late Pueblo III times. The social units of activity related to pottery discard are seen as belonging to the suggested larger dual social groups forming the division of the community.

This analysis demonstrates the usefulness of studying Pueblo utility ceramics for behavioral and organizational interpretations and suggests that this portion of the ceramics field should no longer be relegated solely to simple descriptive lists or functional interpretations.

Chapter 25

Uses of Ceramic Vessels and Grinding Implements: The Pollen Evidence

A surprising aspect of the archeological record at Antelope House is the comparatively small number of complete and restorable vessels and sherds recovered. Most of the complete vessels were found embedded in floor surfaces or included in burials as offerings. A few vessels seem to be associated with ritual structures and activities. We judge these vessels to be primary, or *de facto*, refuse. We were extremely interested in the contents of these vessels, therefore, since we felt functional inferences could be made on that basis.

The embedded vessels, the most numerous class treated here, typically are associated with a hearth. This is true whether the embedded vessels were found inside a room or in an open area, suggesting that the vessels were involved in food storage and/or preparation. All embedded vessels had been recycled from earlier use as cooking containers; as such, they had acquired thick coats of soot on their outer surfaces. When no longer suited to this use, often after development of fine cracks near their bottoms, they were firmly embedded in hard-packed clay floor surfaces and the rims of the vessels were chipped or broken, either through use or in a deliberate attempt to enlarge the opening.

Archeologists often have speculated about the uses of certain types of Southwestern vessels (Longacre 1964), yet in only a few instances were their speculations accompanied by reliable evidence. Vessels which actually contained the preserved remains of such materials as seeds have led some investigators to assign those vessels to use categories. In other cases, ethnographic sources have been used to infer uses for archeological ceramic specimens.

Another method sometimes employed by archeologists to assign ceramic vessels, bedrock mortars and/or grinding implements to possible use categories is the analysis of fossil pollen adhering to the inside surfaces of vessels and to the use areas of grinding utensils (Hevly 1964; Bohrer 1968). This technique is not always successful, since not all vessels or grinding surfaces were used to store or to grind pollen-bearing substances. Some palynologists have obtained limited success in this area of research. Hevly (1968: 89) noted that the washings of metate grinding slabs yielded pollen types which he felt reflected the use of the implement. Bohrer (1968: 48–50) believed that the maize pollen she recovered from certain grinding slabs at sites in the Hay Hollow region represented the use of those slabs to grind maize and assigned similar use to certain manos, which also yielded high percentages of economic pollen.

Method

The present study is concerned with the analysis of soil scraped from the inside bottom portions of ceramic vessels and of pollen residue

Table 198. Sources and dates of Pollen Samples 1, 2, 3, 5, 6 and 7.

	Source	*Provenience*	*Date*
1	Mano	Room 29	Late PIII
2	Mano fragment	Room 5	Late PIII
3	Mano fragment	Grid E 552 (P 123)	Middle PIII
5	Mano	Room 47	Late PIII
6	Mano fragment	Grid J 452 (P 260)	Late PIII
7	Metate fragment	Structure 62	PI

recovered from grinding slabs and grinding stones. Whenever possible, accompanying pollen samples were collected from the surrounding soil matrix and used as a general guide to the fossil pollen types one might expect to encounter in the soil of various portions of the site. In all, 48 pollen samples from vessels and grinding stone surfaces were analyzed, as were 14 associated soil matrix samples. Other pollen samples from Antelope House were analyzed by Gerald Kelso and are included for comparison when appropriate.

Sample Collection

In most cases, the dirt and debris in a recovered vessel were carefully removed and saved for pollen analysis or for seed flotation studies. The soil in direct contact with the bottom interior of each vessel was carefully removed and placed in a sterile plastic bag, which was then sealed and labeled. Care was taken to use clean collecting implements and to avoid pollen contamination from atmospheric sources. Grinding slabs and grinding stones were placed in plastic bags in the field and were brushed clean of surface debris. In the laboratory, the grinding surfaces were washed in a mild solution of dilute hydrochloric acid and the resulting liquids were placed in sterile containers and saved for pollen analysis. Soil matrix samples used for pollen analysis were collected with clean implements and placed in sterile plastic bags. Care was taken to insure proper labeling and to avoid contamination of the fossil samples with modern pollen from the atmosphere.

Pollen Extraction and Identification

Extraction, mounting and analysis of the pollen samples were conducted at the Texas A&M University Palynology Laboratory. Extraction techniques consisted of four basic steps: (1) treatment with hydrochloric acid to remove carbonates; (2) with hydrofluoric acid to remove silicates; (3) with 10 percent potassium hydroxide to remove humic acids; and (4) acetylation to remove cellulose and other nonpolliniferous plant material. The resulting pollen residues were stained, dehydrated and added to small amounts of 2000 cks silicone oil for mounting and analysis.

Standard counts of from 200 to 300 pollen grains were attempted for each sample, as suggested by Barkley (1934) and Martin (1963). Each identifiable whole pollen encountered during analysis was recorded. Recognizable pollen grain fragments also were included in the standard count, but pollen grains that were sufficiently crushed and/or deteriorated to prevent identification were excluded. Unknown pollen types were included in counts, but cryptogramic spores were not.

Pollen counts of 200 to 300 grains were achieved in 47 of the 62 samples examined. Six of the 15 samples containing less than 200 grains were recovered from the surfaces of grinding stones, which one would not normally expect to yield larger pollen counts. The near absence of pollen in the remaining nine samples could have resulted from oxidation, chemical action and/or breakdown by biological agents in the soil.

The identification of pollen types represented in this study was based upon morphological comparisons with modern pollen reference slides stored in the Texas A&M Palynology Laboratory. Pollen from genera in the family Chenopodiaceae and pollen grains of *Amaranthus* were combined into the single category "Cheno-Am," as suggested by Martin (1963), because they are so similar morphologically that it is nearly impossible to distinguish one pollen type from another. Pollen grains in the family Compositae were divided into four categories, based upon pollen morphological differences. High-spine and

low-spine Compositae pollen types were separated on the basis of surface spine length, while the *Artemisia* types are distinctive enough to include in a separate category. Fenestrate pollen types are morphologically distinctive and are included in the category Liguliforae. *Ephedra* pollen was divided into two groups (*E. nevadensis* type and *E. torreyana* type), based upon pollen morphology (Steeves and Barghoorn 1959).

Discussion

After compiling the fossil pollen data from each of the samples used in this study, we found that we often were able to speculate about the probable use of a specific vessel or grinding stone on the basis of its pollen spectrum. However, the assignment of use was possible only when we were able to rule out the possibility of pollen contamination from the surrounding matrix fill. Since it often was impossible to determine the origin of the dirt inside a vessel, we hesitated to assign a use to any vessel which had a pollen spectrum that was similar or identical to the pollen spectrum of the surrounding soil matrix; we felt that in those cases, the possibility for contamination was high.

In the following pages we list each of the samples examined; whenever possible we have tried to assign a probable use.

Pollen Samples 1, 2, 3, 5, 6 and 7

Source, provenience, and date of each of these pollen samples is given in Table 198. Most are secondary refuse. Comparison samples of associated soil matrix material, analyzed by Gerald Kelso, are available for two of these specimens. Pollen Sample 706 was collected directly beneath the mano associated with Pollen Sample 5. Pollen Sample 656 was collected from the floor surface of the grid square in which the mano fragment associated with Pollen Sample 6 was found.

The percentages of pollen types found in each sample are listed in Table 199.

Discussion

The washings recovered from the surfaces of these grinding slabs and grinding stones suggest that certain types of plants and/or seeds containing economic pollen were ground into meal. The high percentages of fossil *Typha*, *Zea* and Cheno-Am pollen undoubtedly result mainly from the grinding of seeds into meal. Bohrer (1968) has noted similar results from the washings of prehistoric grinding slabs from the Hay Hollow archeological site in northern Arizona. Many of the *Zea* pollen grains recovered in this manner from Antelope House were severely torn and fractured, probably as a result of grinding. To test this hypothesis, we placed some modern *Zea* kernels and fresh *Zea* pollen on the pre-

Figure 277. Broken Zea mays pollen grains (a) from Pollen Sample 5, recovered from the grinding surface of a mano from Antelope House, (b) from material found inside a PII widemouth pottery vessel from Antelope House, and (c) from the grinding surface of a metate on which I had ground corn to meal using ancient grinding techniques.

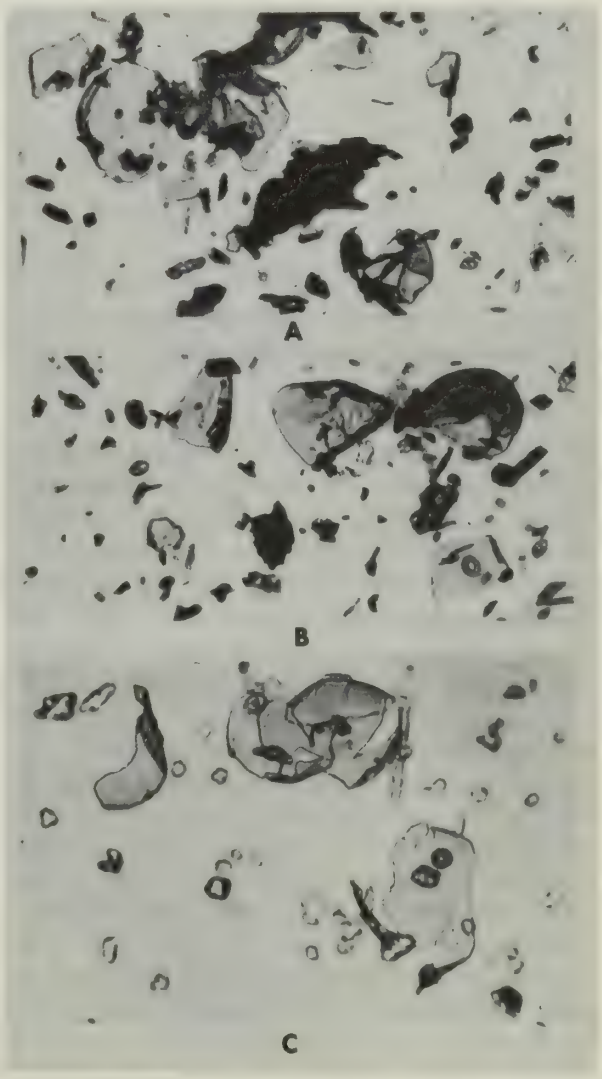


Table 199. Pollen composition of samples studied (percentages).

Sample No.	*Zea*	*Cleome*	*Pinus*	*Cheno-am*	*Typha*	*Populus*
1	17	0	28	11	33	0
2	30.5	0	27	2	27	0
3	9	17	16	8.5	0	0
5	82	0	5	1	4	0
6	2.5	0	62	6	0	0
7	23	0	11.5	27	7	0
706	2	3	52.5	17	0.5	0
656	25	63.5	19.5	15.5	25	0
48	14	31	10	10	17	0
M	43	16	6.5	9	2	0
26	64	2	11	2	0	2
37	50.5	27	2.5	7	0	8.5
39	74.5	13.5	3	2.5	0	2.5
E	68.5	10.5	4	2	0	0
11	83.5	3	2.5	2	2	0
13	70	6	4.5	2.5	6	0
29	52.5	29	4	3	1	0
320	44	21.5	23	26	0	0
43	0.5	5	4	8	29.5	39.5
F	1	16	36.5	9	26.5	2
8	1	0	69	21.5	0	0
15	2	0	66	14	0	2
31	1	0.05	70	22	0	4
162	1.5	0.05	55	6	0	0
12	31.5	0	22	6	0	2
14	19.5	20	24.5	9	0	0
38	25	7.5	35	4.5	0	13
44	5	0	47	13	0	26
222	5.5	5	31.5	8	0	0
400	5	5.5	41.5	14.5	0	0
403	0	1	84	1.5	0	0.5
41	49	12.5	14	1	14	0
42	40	11	12	4	2.5	0

cleaned surface of an ancient grinding slab and ground the seeds into meal. An analysis of residue from the surface of the slab revealed a high number of torn and fractured *Zea* pollen grains, identical with the fossil *Zea* grains analyzed in this study (Fig. 277).

The high percentages of *Pinus* pollen recovered from the same grinding slab surfaces are not interpreted as resulting from the grinding of pine seeds. Although pine seeds often were ground into meal by Southwestern groups, including the Zuni (Stevenson 1915), Chiricahua and Mescalero Apache (Castetter and Opler 1936) and the Havasupai (Spier 1928), pine pollen would not normally become incorporated into grinding surfaces in this way. It is more likely that the pine pollen was present in the atmosphere and settled on the exposed grinding slab when it was not in use. The *Cleome* pollen recovered from grinding slabs could have been deposited during the grinding of dried *Cleome* leaves and flowers. No known ethnographic sources recorded the preparation of *Cleome* in this manner, but some (Castetter 1935; Robbins *et al.* 1916) note that *Cleome* was collected and dried during the spring and summer for use as a food seasoning later in the year. If *Cleome* were stored near these grinding slabs, it is possible that some of its pollen could accidentally have been ground into slab surfaces during the preparation of other foods.

Pollen Sample 48

Pollen Sample 48 (Late PIII) was collected from the inside bottom portion of a corrugated widemouth vessel found embedded in the floor of the Central Plaza Annex, the mouth of the vessel flush with the floor surface. The vessel was found within a few centimeters of Structure

Table 199. Pollen composition of samples studied (percentages)—Continued

Sample No.	*Zea*	*Cleome*	*Pinus*	*Cheno-am*	*Typha*	*Populus*
6	41	13	20	6.5	0	0
10	39	18	3	7	0	10.5
19	71.5	12.5	2	3.5	0	0.5
21	37.5	18	10	12	0	8
28	42.5	25	6	5	0	1
C	73.5	11	7	3.5	0	0
D	56	28	4	3	0	0
9	11.5	36.5	18.5	8.5	0	0
16	22	4.5	31	10.5	0	5
24	11.5	3.5	13.5	13	0	1
25	5	11.5	22	20.5	0	5
35	5.5	35.5	15.5	13	0	4.5
40	21	17	11	9	0	20
47	16	18	11	9	0	4
30	10.5	20.5	9	9	0	8.5
I	99	0.5	0.5	0	0	0
J	17	53.5	1.5	19	0	0
18	30.5	26	12	7	0	5
34	27.5	41.5	3.5	3.5	0	3
32	25.5	7	24	21	0	0.5
314	4.5	4.5	25	34	0	0
17	47	5	11.5	3.5	0	4.5
45	22	67	0	2.5	0	3
865	36.5	41.5	6.5	17.5	0	0
46	52.5	8	11	3.5	0	14.5
K	3	9.5	45	8	0	5
23	26	20	10	12	0	4
27	4	90.5	1	1	1	0
197	20	0	42	10	0	0
20	0	0	38.5	26	0	9
706	2	3	52.5	17	0	0
35	16.5	9	14	21	0	5
847	18	18	22.5	45	0	0

81, a unit labeled a ceremonial shrine on the basis of the 17 carved pahos and the numerous concretions, fossils and other unusual rocks found in and near it; the vessel is considered to be in *de facto* association with the shrine. One of the more interesting aspects of this vessel is the large quantity of crystalline rock salt found in it. Pollen Sample M was collected from directly beneath the jar for comparative purposes (Table 199).

Discussion

The unusually high percentage of fossil *Zea* pollen (43 percent), as well as the 16 percent *Cleome* pollen recovered from the soil matrix makes it difficult to comment on the possible use of this vessel solely on the basis of its fossil pollen content. Under other circumstances, the percentage of economic *Zea* and *Cleome* pollen recovered from the sediments inside the vessel could be considered probable evidence for use, but some of the economic pollen found in this vessel could have come from the surrounding soil matrix. Similar vessels found at Antelope House, however, suggest that this style of corrugated vessel was used primarily for food storage and/or food preparation.

Pollen Samples 26, 27 and 39

These Early PIII samples come from dirt collected along the inside bottom walls of three pottery vessels found embedded in a floor surface and set upright in a row next to a fragmentary wall. The vessels are large black widemouth corrugated vessels, and all were covered with sandstone lids when found. It is suspected that they are associated with the floor of a razed structure in the South Plaza. It is not possible to say whether these vessels were close to a hearth since the area has been extensively disturbed. Each

pollen sample was collected from a different vessel; Pollen Sample E was collected from dirt on top of the original floor surface for comparison with the pollen contents of the vessels (Table 199).

Discussion

The pollen contents of these vessels are similar in composition to the pollen content of the surrounding soil matrix. When found, however, each of the vessels had a sandstone lid in place, so that the surrounding soil matrix probably did not contribute significant pollen contamination. The high percentage of *Zea* pollen in each vessel is seen as evidence for use in food storage or food preparation. We know from ethnographic records (Castetter and Bell 1942, 1951; Hill 1938; Robbins *et al* 1916; Spier 1928) that many Southwestern groups stored vast quantities of *Zea* and *Cleome* for later use. In some cases, both *Zea* and *Cleome* were stored in the corners of interior rooms, hung from the rafters or stored in containers. Although the exact types of containers used for storage are not often specified, it is suspected that certain types of ceramic vessels may have served this purpose. The storage of *Zea* and/or *Cleome* could account for the relatively high percentages of these economic pollen types in the samples from these vessels. The National Park Service excavations at Antelope House yielded no vessels with stored corn, but F.M. Palmer located one such vessel during a 1906 excavation at the site (Fig. 237). Although no notes or related materials remain from this early excavation, it has been established that the vessel came from the South Plaza area and that it dates either to PII or to PIII, probably to the latter.

Another possible source of the economic pollen from these vessels is food preparation. Hill (1938) notes that the Zuni often cut ears of corn into small pieces and boiled them in ceramic vessels to make a soup or gruel seasoned with other plants, such as *Cleome*. Since we doubt that these cooking vessels were well cleaned, we suspect that at least a portion of the prepared gruel adhered to their inside walls, providing the fossil pollen recovered from the vessels.

Pollen Samples 11, 13 and 29

These pollen samples, dating to PII, were collected from three widely separated vessels found on Floor 4 of Room 21. Associated with this room, but higher in the fill, was a cache of 32 ears of flint, dent, and flour corn. Pollen Sample 11 was collected from the inside bottom of a widemouth black corrugated vessel resting in a layer of clean sand. Pollen Sample 13 came from a similar vessel found a few centimeters higher in the fill. Pollen Sample 29 was collected from the inside bottom wall of another similar vessel found resting on the floor surface. All vessels were upright when found and it is unlikely that they were discarded. Other complete and usable artifacts found within the strata (tumplines and a digging stick) reinforce this opinion. A reference pollen sample (No. 320) collected from the floor surface was analyzed by Kelso and is used here for comparison (Table 199).

Discussion

In addition to appreciable quantities of *Zea* and *Cleome* pollen, the soil matrix sample contained a high percentage of Cheno-Am and *Pinus* pollen. The samples collected from the three pottery vessels from these same deposits, however, revealed very high percentages of *Zea* pollen and low percentages of both *Pinus* and Cheno-Am pollen. We feel that the striking difference in the pollen spectra strongly suggests that all three vessels were used for food storage and/or food preparation, specifically that connected with maize. We do not believe that the matrix fill of this room contributed to the pollen contents of the vessels. We suspect that if matrix soil had become incorporated in the soil in the vessels, the fossil pollen percentages of the latter would have more closely approximated the fossil pollen percentages of the surrounding matrix.

Pollen Sample 43

Pollen Sample 43 (Late PIII) was collected from the inside bottom portion of a vessel found inside a slab-lined cist in the northeast corner of Room 29 at floor level 3; a centrally located firepit is associated with this floor. For comparative purposes, Pollen Sample F was collected from the floor surface (Table 199).

Discussion

The high percentage of fossil *Populus* pollen in Sample 43 leads us to suspect that the pottery vessel from which the sample was collected may

have been used for cooking or plant storage. Because the surrounding soil matrix contained only 2 percent *Populus* pollen, we doubt that the 39.5 percent *Populus* pollen inside the vessel could have resulted either from natural atmospheric contamination or from the room fill. The *Populus* pollen could have come from tassels stored in the vessel or from *Populus* pollen and/or tassels added during cooking for their suspected food or medicinal value. Elmore (1943) notes that the Navajo chew *Populus* catkins (tassels) as others might chew gum and that *Populus* pollen often was used for medicinal purposes or in religious ceremonies. Castetter and Underhill (1935) mention that certain Southwestern groups, including the Papago, often maintained a sort of "perpetual soup" or *pot-au-feu* cooking on hearths throughout most of the day. These soups were very thick and could be described as a gruel to which a variety of ingredients were periodically added. Ingredients included ground meal, flour and plants considered useful as seasoning agents. Although he does not specifically mention *Populus* tassels, their use for this purpose is possible.

Pollen Samples 8, 15 and 31

These late PIII pollen samples were collected from the dirt inside a black widemouth corrugated jar embedded in the hardpack of the uppermost floor surface in Room 22. The mouth of the vessel was flush with the floor surface and was not covered with a lid. When in use, this floor was actually a small outside plaza, with a ramada and hearth nearby. Pollen Samples 8 and 31 were collected from sediments in the inside bottom portion of the vessel, while Pollen Sample 15 was collected from dirt in the middle of the vessel. Pollen Sample 162, collected from sediments on the floor surface and analyzed by Kelso, is included for comparison in Table 199.

Discussion

Comparison of the three pollen samples from this vessel with the percentages of fossil pollen recovered from the surrounding soil matrix allows some limited speculation about use. The vessel, a corrugated jar, contained high percentages of fossil Cheno-Am, in comparison with the 6 percent Cheno-Am pollen found in the surrounding midden soil. Noting that the highest percentages of Cheno-Am pollen were recovered from soils found along the inside bottom portion of the vessel, we suggest that the vessel may have been used to store *Chenopodium* and/or *Amaranthus* seeds. These seeds were widely used by aboriginal groups in the American Southwest. Elmore (1943), for example, notes that the Navajo often chewed both *Chenopodium* and *Amaranthus* seeds fresh for their sugar content or stored them to be ground later into meal for gruel or bread. Although not specified in Elmore's report, it is possible that such seeds were stored in ceramic vessels of the widemouth corrugated type. Such vessels would seem a logical choice, since the storage of these seeds in baskets could have resulted in some loss to rodents.

Pollen Samples 12, 14, 38 and 44

These pollen samples were collected from vessels found inside a square slab-lined cist below the floor of a rectangular kiva (Room 18). The kiva was one of the last rooms constructed at Antelope House, but it is not known whether the cist was an integral part of the kiva, being opened and used from time to time, or was covered up during construction of the kiva. An obvious clay patch on the floor of the kiva might indicate that the cist was open after the kiva had been constructed. This patch, however, contained one of a set of loom anchors, and since this loom anchor would seem to be a permanent architectural feature, it suggests that the cist was opened rarely, if ever. The kiva itself remained in use for about 25 years (AD 1240–1265).

Pollen Sample 12 was collected from the dirt adhering to the inside bottom of a black-on-red jar. Pollen Sample 14 came from soil along the inside bottom of a widemouth black corrugated vessel. Pollen Sample 38 was collected from dirt in the inside bottom portion of a similar vessel. Pollen Sample 44 comes from the inside bottom of a black plainware bowl, which was heavily sooted on the outside. All date to Late PIII. Four additional pollen samples were collected from the soil matrix inside the slab-lined cist. Pollen Samples 222, 400, and 403, analyzed by Kelso are included for comparison in Table 199. Pollen Sample 681, analyzed by us, contained no pollen.

Discussion

The dirt matrix samples yielded low per-

centages of *Populus, Cleome* and *Zea* pollen and high percentages of *Pinus* pollen. Examination of the fossil pollen recovered from two of the ceramic containers (P.S. 12 and P.S. 14) revealed high percentages of *Zea* pollen, suggesting that these vessels may have been used to store raw or prepared maize. The maize could have been stored either whole or ground, since Bohrer (1968) has noted that *Zea* pollen can be recovered from both husks and kernels. Our studies of grinding stone surfaces show that *Zea* pollen can also be incorporated in prepared meal or flour during the grinding process.

The fossil pollen recovered from the black widemouth corrugated vessels suggest their use in food storage and/or in food preparation. In Pollen Samples 38 and 14, large amounts of *Zea* and *Cleome* were found. The percentages in both samples are much higher than those of the same pollen types in the surrounding matrix soil sample; we do not believe that the surrounding matrix soil can be considered the source of the economic pollen inside the vessels.

Although Pollen Sample 44 was recovered from the inside of a black plainware bowl that was heavily sooted on the outside, it is suspected that the recovered fossil pollen reflects the general composition of the surrounding matrix, rather than being an indicator of use. This assumption is based upon the similarity of pollen percentages in Pollen Sample 44 and Pollen Sample 400. Note that a loom anchor was placed precisely in the middle of this vessel when the cist was sealed.

Inasmuch as we are dealing with a subfloor cist sealed by the prehistoric users of this kiva, the obvious and most parsimonious inference is that this pollen was deposited as part of ritual activity involving the vessels and the cist.

Pollen Samples 41 and 42

Pollen Samples 41 and 42 were collected from the bottom inside portion of a widemouth black corrugated pot, which was embedded in the upper floor surface of the South Plaza. The samples date to PIII. Nearby is the largest hearth at the site. The empty vessel was buried so that its top was flush with the floor surface. Pollen Sample G was collected from the floor surface surrounding the pot and is included for comparison in Table 199.

Discussion

As mentioned above, many of the pollen counts recovered from soil inside the widemouth black corrugated jars at Antelope House suggest a use associated with the storage and/or cooking of foods. It is suspected that the corrugated jar from which these two pollen samples were collected may have been used in a similar manner, but the pollen data do not clearly support this assumption. The fossil pollen record from the jar and from the surrounding soil matrix are similar. The fossil pollen recovered from the vessel could have come from the matrix fill.

Pollen Samples 10, 19, 21 and 28

These samples were recovered from grave goods associated with Burial 5, an unusually elaborate interment of a child with numerous pathologies. The burial is the only one with a constructed cover reported from the site and contained a relatively large number of grave goods, including ceramic vessels, a cradleboard and the usual matting and turkey feather robe wrapped around the body. This child was the only individual recovered who was buried with items of personal adornment (a bead necklace and wrist bracelet). The ceramic vessels associated with the burial are a "black pitcher" (FS 190), a black-on-white pitcher (FS 191), a black-on-white bowl (FS 192), and a Wingate Black-on-red bowl (FS 193). The last three were nested; 193 contained 192, which contained 191. Pollen Samples 10 and 19 were collected from one vessel, the former from dirt in the center of the vessel, and the latter from dirt adhering to the inside bottom of the vessel. Pollen Samples 21 and 28 were collected from a second vessel, the former from dirt in the center of the vessel, and the latter from dirt adhering to the inside of the vessel. All date to Middle PIII. Pollen Samples C and D were collected from dirt used as grave fill and are included for comparison in Table 199.

Discussion

The two samples collected from the soil matrix contained high percentages of *Zea* pollen, some *Cleome* pollen and low percentages of *Pinus* and Cheno-Am pollen. The unusually high percentage of *Zea* pollen may have come from the cultural refuse used to fill the pit, or it may have

been introduced intentionally in large quantities as part of a graveside ceremony. Ethnographic sources do not state specifically that *Zea* pollen was ever used in this manner, but many types of pollen (including *Zea*) were often used in ritualistic ceremonies, especially among the Navajo (Hill 1938; Elmore 1943). We suggest that the prehistoric inhabitants of Antelope House may have used pollen (i.e., *Zea*) in some graveside ceremonies.

Because of the similarity of fossil pollen percentages in the matrix soil samples and in the soil samples recovered from the vessels, we hesitate to speculate about the uses of those vessels; the possibility of contamination is high.

Pollen Samples 9, 16, 24, 25, 33, 40 and 47

These pollen samples, dating to Middle PIII, were collected from grave offerings in a burial of an adult male. The burial, recovered from the fill of Room 29, contained considerably more grave goods than any other adult burial at the site. Pollen Sample 9 was collected from soil found along the inside bottom wall of a small cup-shaped jar. Pollen Sample 16 is from dirt adhering to the inside bottom wall of a Wingate Black-on-red bowl, which had been broken but which was repaired before being placed in the burial. Pollen Sample 24 was collected from dirt in the bottom of a widemouth black corrugated jar. Pollen Sample 25 comes from the dirt inside a plainware pottery dipper, which was found inside the black corrugated jar mentioned above. Pollen Sample 33 was collected from dirt along the inside bottom wall of another large black corrugated jar, which was covered on the outside with soot. Pollen Sample 40 comes from the inside bottom of a third black widemouth corrugated jar. Pollen Sample 47 comes from dirt scraped from the inside bottom of a badly worn decorated bowl, which had been blackened on the outside from repeated use in or near an open fire. Pollen Samples A and B were collected from the soil matrix of the burial for comparison, but they contained no pollen. The pollen content of samples from vessels is presented in Table 199.

Discussion

The difficulty of assigning use on the basis of the fossil pollen contents of these vessels is compounded by the absence of fossil pollen in the two soil matrix samples. For some of these vessels, however, we feel that a reasonable inference can be made if both their shapes and their fossil pollen contents are considered. The small jar-shaped vessel that yielded Pollen Sample 9 does not appear to be a cooking vessel. Its pollen contents included a high percentage of *Cleome* and/or *Zea*. Pollen Sample 16 came from a shallow ceramic bowl, which contained a high percentage of *Zea* but only a weak representation of other economic pollen types, such as *Cleome* or *Populus*. If this vessel had been used to store ground corn or as an eating utensil, *Zea* pollen could have adhered to the inside wall of the bowl. The high percentage of fossil *Pinus* pollen in this sample may represent noneconomic use, or it may reflect pollen from the matrix soil in the burial. The bowl, because of its shape, may also have provided an excellent trap for airborne pollen; Bohrer (1968) has pointed out that pine pollen blowing over the surfaces of small concave depressions or pits can, in this way, become overrepresented in the fossil record. Pollen Sample 24 was collected from inside a corrugated jar that we suspect was used for food preparation or food storage. Because economic fossil pollen was not present in this vessel at the same high levels found in other vessels of this type in other parts of the site, we hesitate to assign it a use solely on the basis of its fossil pollen contents. Pollen Sample 25 contained relatively low percentages of *Zea* and *Cleome* pollen and a high percentage of Cheno-Am pollen. The Cheno-Am pollen could have become trapped on the interior surface of this ceramic dipper if it were used to transfer *Chenopodium* seeds from one container to another or to serve some type of cooked meal containing ground *Chenopodium* seeds. In either case there is a high probability that Cheno-Am pollen could have been deposited along the inside surface of the dipper. Pollen Sample 33 came from a large widemouth corrugated vessel that may have been used to store *Cleome*. An alternate possibility is that *Cleome* plants may have been placed in this vessel as part of the grave offering. The other fossil pollen types in Sample 33 are suspected to have entered the pot as part of the burial matrix. Pollen Sample 40 was collected from a corrugated jar blackened with soot. This vessel may have served as a cooking utensil for

meals containing *Zea, Cleome* and *Populus* tassels. An alternate possibility is that such food items may have been left in the vessel as part of the grave offering and that fossil pollen was all that remained when it was found by the archeologist. Pollen Sample 47 came from the soil inside a small shallow bowl, which may have been used as an eating utensil. This is difficult to determine, however, owing to its low yield of economic pollen types.

Pollen Sample 30

Pollen Sample 30, dated to Late PIII, was collected from the inside bottom portion of a widemouth black corrugated vessel found on the surface of Floor 29 in the South Plaza. No matrix samples from outside the vessel were collected for comparison, but the area contained abundant preserved turkey feces, and two samples of this material were analyzed for pollen. The turkey feces samples are designated Pollen Samples I and J in Table 199.

Discussion

The fossil pollen contents of Pollen Sample 30 reflect no clear use, unlike many similar corrugated vessels. Fossil pollen recovered from the two fecal samples included high counts of economic *Zea, Cleome* and Cheno-Am. Some of the abundant turkey feces in that region of the site could easily have fallen into the vessel, contaminating whatever pollen may originally have been present, so that we feel it is unwise to assign a probable use.

Pollen Samples 18 and 34

Pollen Samples 18 and 34 were collected from the inside bottom portion of two widemouth black corrugated vessels found embedded in an ancient floor surface near a fire hearth. Each vessel was buried with the top of the rim flush with the floor surface. Both date to PIII. Pollen Sample H was collected from dirt adhering to the original floor surface for comparison with the pollen samples from the vessels (Table 199), but it contained no pollen.

Discussion

Unfortunately, we have no fossil pollen comparison upon which to base a reasonable inference about use of the vessels in question, but certain observations can be made. Both samples were collected from soil along the inside bottom portions of widemouth black corrugated jars, which in other areas of the site are suspected of being associated primarily with food preparation and/or food storage. The pollen from both vessels contains high percentages of *Zea* and *Cleome* pollen, which could have resulted from use. As in some other instances, however, these fossil pollen types may have entered the vessels as part of the matrix soil that later covered the floor surface.

Pollen Sample 32

Pollen Sample 32 (Late PIII) was collected from the inside bottom portion of an open bowl, which was blackened with soot on the outside and broken. The vessel was associated with Burial 8 in Room 48 and probably was part of the grave offering. Pollen Sample 314 was collected from the associated burial fill and is included for comparison in Table 199.

Discussion

The associated soil matrix sample yielded a low count of both *Zea* and *Cleome* pollen, whereas the sample collected from inside the bowl contained 25.5 percent *Zea* pollen and 7 percent *Cleome* pollen. It is suspected that these higher percentages of fossil economic pollen may represent pollen which adhered to the inside of the vessel during its use for food storage or food serving. The blackened underside of the bowl suggests that it may have been placed on a fire, perhaps to heat food. If the vessel was not carefully washed after each use, some portion of the food (containing the pollen) could have remained on its surface. This pollen could later have become mixed with the dirt which filled the bowl.

Pollen Sample 17

Pollen Sample 17 (Early PIII) was collected from the inside bottom portion of a widemouth black corrugated jar found buried beneath the south exterior wall of the site. The vessel was sitting on what may have been an ancient floor surface. Pollen Sample L was collected from soil directly beneath the vessel, but it yielded no pol-

len. The pollen contents of Sample 17 are listed in Table 199.

Discussion

That Pollen Sample 17 contained a high percentage of *Zea* pollen strongly suggests a use involving food storage and/or preparation. Because the sample from the associated soil matrix contained no fossil pollen, it is difficult to determine what influence, if any, the matrix fill might have had on the pollen spectrum of the material in the vessel.

Pollen Sample 45

Pollen Sample 45, dating to PII, was collected from the inside bottom portion of a widemouth black corrugated vessel found partially buried in the floor in the southwest corner of Room 29. A comparison sample was collected from the room's original floor surface, which contained a central rectangular hearth; Pollen Sample 865 was analyzed by Kelso and is included for comparison in Table 199.

Discussion

Due to the similarity of the two samples, we believe it is possible that the fossil pollen contents of the vessel may have entered as part of the depositional fill in Room 29. No statements about probable use seem appropriate, therefore, although a culinary or storage use might be implied by the pollen data and by the shape of the vessel.

Pollen Sample 46

Pollen Sample 46, dating to Middle PIII, was collected from the bottom inside portion of a widemouth corrugated vessel found below Floor 3 in Room 22. Pollen Sample K was collected from the associated soil matrix outside the vessel and is included for comparison in Table 199.

Discussion

The soil matrix sample contained low percentages of *Populus* and *Zea* pollen, while Pollen Sample 46 was rich in both of these economic pollen types. On the basis of these data, we suspect that the vessel was used in the storage and/or preparation of foods, especially those containing maize and *Populus* catkins or pollen.

Pollen Sample 23

Pollen Sample 23, dating to Middle PIII, was collected from the bottom inside portion of a widemouth corrugated vessel found embedded in an area filled with preserved turkey feces. Unfortunately, no comparison pollen samples were collected from this floor surface during excavation. Sample 23 contained 26 percent *Zea*, 20 percent *Cleome*, 10 percent *Pinus*, 12 percent Cheno-Am and 4 percent *Populus* pollen.

Discussion

The fossil pollen recovered from this vessel may reflect its use. The relatively high percentages of both *Zea* and *Cleome* suggest food storage or food preparation. Owing to the absence of a comparison sample, however, we were unable to determine what types of pollen may have entered the vessel as part of the matrix fill.

Pollen Sample 27

Pollen Sample 27, dating to Late PIII, was collected from the inside bottom portion of a widemouth black corrugated vessel found buried in Floor 2, Room 16, with its top rim flush with the floor surface. A hearth was found nearby on the same floor level. Dirt scraped from the surface of the floor was designated Pollen Sample 197 and is included for comparison in Table 199.

Discussion

Pollen collected from the floor surface yielded high percentages of *Zea* and *Pinus* pollen, but little *Cleome* pollen. The soil collected from the corrugated jar, however, contained an abnormally high percentage of *Cleome* pollen, but little *Pinus* and *Zea* pollen. This striking difference in the pollen spectra strongly suggests that the vessel was used to store *Cleome* plants for food or for medicinal purposes. The prehistoric and historic economic use of *Cleome* in this manner in the American Southwest is well documented.

Pollen Sample 20

Pollen Sample 20, dating to Late PIII, was collected from inside a Mesa Verde Black-on-white mug found resting on the floor of Kiva 47. The kiva was filled very late in the history of

Antelope House. Because it was broken, this mug probably was discarded in the material used to fill the pit. A matrix sample of the fill (P.S. 706), analyzed by Kelso, is included for comparison in Table 199.

Discussion

The fossil pollen recovered from the soil matrix is very similar in types and percentages to the fossil pollen recovered from the mug, prompting us to speculate that the pollen from both samples had a similar origin. If the mug were used for purposes other than food storage or food preparation, it probably would lack economic pollen at the time it was discarded and thus could only reflect the pollen spectrum of the matrix fill from which it came.

Pollen Sample 35

Pollen Sample 35, dating to Late PIII, was collected from dirt inside a narrowmouth ceramic vessel found buried beneath Floor 4 of Room 1. Soil matrix directly beneath this vessel (P.S. 847) was collected and is included for comparison in Table 199.

Discussion

The pottery vessel associated with Pollen Sample 35 is a narrowmouth Sosi Black-on-white jar with a constricted neck; it does not appear to be suitable for food storage or food preparation. The pollen spectrum from the soil inside this vessel reinforces this view. Because the spectra of fossil pollen from inside the vessel and from the associated soil matrix are quite similar, it is possible that both came from the soil used to fill the area below the floor of Room 1.

Summary and Conclusions

On the basis of pollen data, we have assigned tentative use to a number of ceramic vessels and grinding stones dating from Pueblo I, II, and III. In many instances, use seems to be directly linked to food preparation and/or to the storage of foods, primarily *Zea* (maize), *Populus* (cottonwood), *Cleome* (beeweed), *Typha* (cattail) and Cheno-Am (goosefoot and amaranth).

Contrasting the data in terms of (a) use clearly indicated/use not clearly indicated, (b) association with hearth/without hearth/ritual (burial or kiva cache), and (c) embedded/portable shows the following relationships: (1) embedded pot interior pollen samples are not consistently distinguishable from their control samples, (2) samples from portable pots are more likely to be clearly distinguishable from their control samples, and (3) the occurrence of economic pollen types is so high in both embedded and portable vessels that involvement in food storage and preparation is indicated.

An intuitive model is proposed to fit these observations. If embedded vessels, a hearth and the surrounding space are used habitually for food preparation, then spillage and wind drift will impart the same pollen spectra to pot interiors and to the immediate floor area, regardless of later contamination of the pot interiors by archeological fill. Portable pots, because they are readily moved from place to place, are more likely to be found in the archeological record in areas where food preparation was not practiced habitually and which consequently have contrasting pollen spectra; such contrasting environments would include burials and ritual caches.

Chapter 26

The Bone Artifacts and Experiments in Bone Tool Production

Theoretically, a study of tool configurations, wear patterns, and ornament design should yield information on tool function and on the possible use of decorative ornaments. In this study, an experimental tool manufacturing design was created to generate firsthand evidence of wear patterns produced on new tools. These patterns were macroscopically and microscopically compared with those of similar type from the artifact collection, and their similarities and differences were noted.

With the finished product (the artifact) as an ideal type and guide, the manufacturing process was replicated with modern bone. The study hopes to shed light not only on the production of bone implements, but also on the behavior associated with them.

Several aspects of the process were of special interest: How much time was required to make a tool of a particular type? What kinds of movements in the abrading process produced the striations observed in the artifacts? How did the manufacturing process affect the other implements (chert, antler, hammerstone, and sandstone) used in the production of the tool? Is the difference between new and old bone sources important?

Method

Each bone artifact was measured; in some cases, three numbers appear in this report and should be read as length, width, and thickness, respectively, expressed in millimeters. No dimensions were recorded for some items, due to the fragmentary nature of the artifact or bone. Bulk bone and unconsciously modified bone fragments are not included in this report.

Categories of artifacts were selected and a categorized card file was established. Final analysis was by categories; when possible, I attempted to segregate units into provenience and period categories, as well.

Given the small number of artifacts, several categories of morphologically different tool types could be lumped together on the basis of wear patterns, physical dimensions and method of manufacture. These data should prove reliable. Many different methods of categorizing tool and ornament types are to be found in the literature (Semenov 1964; Kidder 1932; etc.), and this study utilizes information from many sources.

Like a modern tool kit, in which are found different tools for different functions and in which different behavior is associated with each tool type, the collection of tools and other worked bone artifacts from Antelope House may represent different activities. Due to the lack of ethnographic evidence concerning the use of bone tools, suggested probable uses of bone tools are based on co-occurrences with other artifacts and on comparison with tools from other sites (Kidder 1932; Di Peso 1974).

Experimental Tool Production

Function cannot be assessed with 100 percent accuracy through an examination of wear patterns. Humeri "fleshers," for example, originally were assumed to be designed for removing the fat and muscle residue from green hides. Experimentation by Osborne (1965) later demonstrated that humeri "fleshers" actually are vegetable fiber scrapers. Wear and polish patterns similar in length and configuration were obtained on humeri scrapers of modern manufacture in Osborne's experiment.

Several tool types were made for this study: (1) a splinter awl, (2) a humerus-type scraper, (3) a robust pointed awl similar in length and

configuration to a metapodial awl, and (4) a "gaming piece" or die. All processes involved in bone implement manufacture were observed, as were the effects on materials (chert, sandstone, and antler) used to work the bone.

Striation Patterns on Bone

Three patterns are basic: sawing, grinding, and drilling.

Sawing is done with a sharp lithic implement. A chert projectile point from the White Mountains region of central Arizona was used in this experimental study. Using an antler as a pressure flaking tool, I flaked a serrated edge on the projectile point, thereby creating a saw. This procedure required less than one minute.

Sawing back and forth across the shaft of a fresh sheep femur was at first difficult. Side slippage was frequent and each slip left its mark on the bone shaft. Once a shallow groove was begun, the edge of the chert cut deeper and slippage was reduced. By slowly rotating the shaft of the bone and grooving the shaft in 2 mm to 3 mm increments, a transverse incision was created, completely encircling the bone shaft. As the bone shaft cortex is 3 mm to 4 mm thick in most places, approximately 20 minutes were required to saw completely through to the medullary cavity and to remove the articular end of the bone. The process was repeated for the other epiphysis, yielding a bone tube 75 mm in length.

The wear patterns observed on both the bone tube and the cut ends were, as would be expected, the same. The chert cut (in cross section) left a V-shaped incision in the bone. Edges of this cut were polished and had striations around the circumference of the bone shaft. Striations left by side-slippage were random and ran transversely across the bone shaft.

Sawing a bone longitudinally is a more difficult task. Using the tibia of a pig, I attempted to cut out a long shaft splinter, 100 mm or more in length. Side slippage was frequent. The bone was extremely greasy. After spending approximately 20 minutes on each cut, I attempted to use a hammerstone to break the shaft splinter away; this attempt failed. As my hammerstone was too small, I utilized the pig's femur as a hammer (distal epiphysis striking surface). The tibia shaft broke along the incised cuts, but the splinter also broke in half. I modified one fragment of 111 mm into a splinter awl of the robust type and one fragment of 83 mm into a fine-pointed splinter awl. A very small (32 mm × 12 mm) chip was modified into the gaming piece.

Excess bone was chipped away from the shaft aplinter to form a splinter awl by using a small quartz pebble hammerstone. Care had to be exercised in placing the edge to be chipped at the proper angle on the anvil stone (in this case a sandstone block from Antelope House), as an improper angle would shatter the shaft splinter. Once the idealized shape was obtained, I experimented with different grinding techniques.

Questions have been raised about so-called awl sharpening grooves found in the sandstone walls at Antelope House. Deep narrow grooves of this kind would seem to indicate a backward-forward or push-pull type of grinding. I found this technique to be extremely tiring, since friction is created along the entire surface of the tool being ground. Examining the points of awls, fleshers and other implements, I found very few which seemed to have been initially or subsequently sharpened in this manner. The striations left on the bone by this method of manufacture are longitudinal to the bone shaft. On the vast majority of bone shafts, edges and points, I found evidence of transverse striations.

What grinding techniques would leave marks of this type? By holding the bone near the edge of the sandstone and abrading with a side-to-side motion, transverse striations were created on the bone. Side-to-side grinding placed less of the bone shaft on the grinding surface, creating less friction, and the bone was easier to work. It also was a more efficient technique, as this hand motion is quicker than a back and forth motion. By changing the angle of the bone tool, edges and butts can be ground round or flat, points can be placed on splinters, etc., with relative ease. The time required to grind the working surface on the flesher was only 20 minutes. Striations on its surface were remarkably similar to those found on Antelope House humeri fleshers.

After working a point or working edge on a bone tool, it was found that grinding need not remove more than 1 mm of the original length of the blank. The flesher blank I worked was 74 mm in length, as was the finished product.

The interior and exterior surfaces of the small bone chip were ground flat, again using a side-to-side motion. The chip was held under the index and middle fingers. After grinding the

chip into a roughly oval shape, four incisions were cut into one surface, approximating the depth and length of those found on Antelope House dice. Grinding required 15 to 20 minutes; incising required 30 minutes. Holding onto the small bone while exerting pressure during cutting proved to be a problem. It is my opinion, too, that a longer cutting tool would have been easier to control than was the one used in my experiment.

Wear Patterns on Nonbone Surfaces:

Sandstone

The surface of the sandstone was virtually unaltered after nearly two hours of continuous back-and-forth and side-to-side grinding. Bone flour was produced as the bone material was ground down. A sharp puff of air was sufficient to clear the sandstone of this residue. A buildup of bone flour reduced grinding efficiency markedly.

Chert

The cutting edge of the chert wore down after about five minutes of sawing. A sharp edge was not needed, however, as the saw apparently cut no better during the initial minutes than it did later on. Nevertheless, I retouched the edges twice with the antler flaker during the course of tool manufacturing.

Antler

Initially pointed sharply, the antler tine tip became dull and faceted after retouching the chert blade. The antler's working point lost its effectiveness when dull, but grinding the point to a rounded shape restored its efficiency.

Hammerstone.

The edge of the stone which made contact with the bone contained bone chips and bone flour in its interstices. This can be easily removed, however, by simply rubbing the area. Sufficient energy was not used to shatter either hammerstone or sandstone faces.

Other Observations

By placing points on the implements in the last phase of work, it was found that striations created during preparation of the shaft blank were obliterated. Side-slippage striations usually were retained on the bone shaft when longitudinal, but they are indistinguishable when transverse and among transverse striations. The most recent abrasion marks will obliterate any previous striations or wear patterns, creating problems for examination of tool wear patterns and "use lengths," or depths of tool penetration.

Tool sources should be expected to come from freshly killed animals, since bone becomes brittle after exposure to weather. Fresh bone is easier to work with than is older bone. Daily handling of bone implements might decrease their brittleness through absorption of the natural body oils of the user, but this is speculation. Bone certainly was polished by abrasion of palms and fingers and consequently application of natural body oils. Bone ornaments may have been polished by abrasion with leather or smooth pebbles.

Splinter Awls

The most numerous bone artifacts examined in this study belong to Kidder's (1932) Class E awls, here designated splinter awls. Splinter awls are defined as a fragment of bone lacking the condyle on both ends. One hundred four splinter awls were recovered from Antelope House, including complete and fragmentary specimens.

There are several types of sources for splinter awls. The first, a primary unutilized bone, could be incised longitudinally in several areas at the desired width, yielding a shaft splinter. In this case, the edges of the sides of the awl will appear polished, with longitudinal striations (i.e., those running the length of the tool) on its surface. These incising, or sawing, striations usually are deeply embedded in the bone and remain despite use, except (1) when they are obliterated in the area of the working end (i.e., the point), in which case they will be completely worn out, or (2) when subsequent resharpening of the point or shaft replaces the parallel striations with the perpendicular striations indicative of side-to-side grinding.

The second tool source is a simple unprepared bone splinter, perhaps a shaft fragment from a bone broken open to extract its marrow or for use in bone grease preparation. This bone fragment will have rough edges, unlike those of the prepared blank. If the edges of the blank are not sharp, the toolmaker may decide to leave them as they are; if they are, the user may grind

the edges on a hard surface, usually sandstone, which is the most abundant abrasive material in the area. The majority of the splinter awls examined evidence side-to-side grinding, which leaves perpendicular striations on the tool edge.

If the tool is used for long periods, handling causes polishing of the shaft and edges. The interior surface (i.e., the site of the medullary cavity) can also become polished. Abrasion from handling and chemical action from sweating can contribute to the polishing of the bone.

Treatment of the nonworking end, or butt, of the awl has three variations. In the small to medium length awls (47 cm to 80 cm), the butt of the tool presses against the palm of the hand, prompting toolmakers to grind the butt ends flat or round. In general, round-ended splinter awls outnumber flat-ended splinter awls by approxmiately two to one at Antelope House. Unaltered ends usually occur on awls which presumably did not press against the palm of the hand, but this is speculation. No awls were found to have handles of hide or cord, which would have given added comfort when using the tool.

Types of Points

Two types of splinter awl points were observed in the specimens examined. A robust point is found on those tools with wide (generally over 1.5 cm) shafts. The shaft of the tool tapers abruptly to the point and the cross section of the point and shaft are roughly rectangular. A fine point is found on tools with narrower shafts, which taper continuously from the butt end to the point. This type also is characteristically rectangular in cross section, but the pointed (working) end is more likely to become rounded with continued use and resharpening. In Late PIII, during which 49 of the most complete dated splinted awls were manufactured, 25 had rectangular cross sections and eight had rounded cross sections.

Use Length

Use length is defined as that area, when visible, in which all striations (either parallel or perpendicular) are obliterated by use. Splinter awls probably were used exclusively in the manufacture of baskets, so that wear was caused by pushing them through coils of vegetal material, such as yucca. The siliceous nature of such fibers would, over time, wear down a pointed bone tool until it would require resharpening. Of the 104 awls, only 68 could be examined for use length; this measurement varied from 4 mm to 43 mm. Robust-pointed awls had use lengths in the lower range, due to their more abruptly tapering points. The fine-pointed awls, with their narrower shafts, were capable of greater penetration of worked material and had ranges at the higher end of the scale. An average use length of 12.3 mm was calculated for the 68 awls in question; this length would appear to be adequate for insertion of the tool through basketry materials to allow enough space for passing the next splint through to the other side of the basket. Rectangular cross sections would allow for a slight lifting action of the rod bundle if the awl were twisted, which would facilitate passage of the splint. This feature may account for a three-to-one ratio of rectangular to circular cross sections, although striations on the edges of the points do not indicate twisting or rotation.

Animal Sources of Splinter Awls

By far the most common animal sources for the manufacture of splinter awls were the artiodactyls, which in this environment include the mule deer (*Odocoileus hemionus*), the pronghorn (*Antilocapra americana*) and the bighorn sheep (*Ovis canadensis*). Elk (*Cervus canadensis*) may also have been used, although no element diagnostic of this species was found. Of the 104 splinter awls examined, 85 are attributed to the large mammal category, which, I believe, can safely be interpreted as artiodactyls. More specific identification would be hazardous, due to the degree of cultural alteration of the bone. The animal sources of splinter awls are listed in Table 200.

The nonartiodactyls were the sources of the greatest number of fine-pointed awls, a result of their narrower shafts.

Changes in Splinter Awls Through Time

A steady increase in the number of splinter awls is apparent from BMIII to Late PIII, which may be accounted for by both natural and cultural factors. For example, awls may be removed culturally from the archeological context through trade, discard, burial, or intentional destruction. Natural factors include destructive chewing by dogs and rodents, accidental fires and accidental breakage. One should also suspect recycling of tool specimens by later inhabitants of Antelope House. As we approach Late PIII, therefore, splinter awls should, and do, outnumber those from earlier proveniences.

Table 200. Sources of splinter awls.

Species	Element								
	Indeterminate	*Metapodial*	*Tibia*	*Femur*	*Ulna*	*Radius*	*Tarsometatarus*	*Tibiotarsus*	
Meleagris gallopavo	0	0	0	0	0	0	1	4	
Leporid	3	0	0	0	0	0	0	0	
Sylvilagus sp.	0	0	3	0	0	0	0	0	
Lepus californicus	0	0	1	0	1	2	0	0	
Canis sp.	1	0	0	0	0	1	0	0	
Odocoileus sp.	0	0	1	0	0	0	0	0	
Artiodactyla	28	50	6	1	0	0	0	0	
Med. Mammal/Large-Average	1	0	0	0	0	0	0	0	
	33	50	11	1	1	3	1	4	Total 104

Another factor must be considered with regard to frequencies not only of awls, but also of all worked bone. Because of the superposition of latter structures over earlier ones, it was impossible to recover much of the earlier material without destroying later structures. This problem of differential sampling was corrected for floral material by measuring relative volumes from each provenience unit. These corrective factors could then be applied to earlier and later proveniences to determine whether an increase actually occurred. This method (using a "correction factor") proved unsatisfactory for the worked bone material from the site, since the figures calculated reflect only a hypothetical relative number of specimens.

Provenience Associations

There seem to be no great changes in splinter awl concentrations in room proveniences through time. An average of one awl per room is the rule. Exceptions were noted for adjoining Rooms 21 and 29. from which 11 and five splinter awls, respectively, were recovered.

Kiva proveniences, including Room 47, yielded 23 splinter awls. High concentrations of tools in kivas may indicate specialized activity areas. Because the majority of proveniences represent refuse, materials from those areas cannot be used to demonstrate activity areas.

Those tools found in *de facto* deposits (e.g., on floors) were scarce; these will be discussed below.

If splinter awls were indeed basket weavers' tools, their kiva proveniences might lead one to postulate basket manufacture in kivas. Other possible uses of splinter awls include leather and hide working tools and pressure flakers for the manufacture of projectile points or other lithic tools. Chipped points on 27 splinter awls may be a result of their use as pressure flakers. Antler flakers are by far the best tools for pressure flaking, but if none are available, a similar bone tool could suffice. It may be for this reason that splinter and metapodial awl tips are found to be chipped and broken.

Six splinter awls were recovered from the Tower Corridor and 15 were recovered from the South Plaza. All other areas had low concentrations of splinter awls (approximately one per provenience).

Metapodial Awls

The metapodial bones of artiodactyls are the most common mammal source of tool blanks at Antelope House. Forty-five metapodial awls from bones of three genera of animals were examined: bighorn sheep contributed three awls, mule deer contributed 18, one was produced from an Antelope metapodial, and 23 were identified simply as artiodactyl in origin. Again, cultural alteration of bone features in the artiodactyl category made specific identifications difficult.

Metacarpal and metatarsal bones together are referred to as metapodial bones in artiodac-

tyls. These are long tubular bones, which, in the developmental stages, are comprised of two individual, lightly fused bone tubes. As the animal matures, these bones fuse and a bone roughly H-shaped in cross section (ends closed) results. The midbone suture disappears anteriorly and a slight depression forms posteriorly on metacarpals; a deep groove is found anteriorly and posteriorly on metatarsals. The bone worker merely deepens these natural grooves with a stone tool, splitting the bone from the proximal to distal epiphysis. The two resulting blanks, each retaining one of the distal condyles of the metapodial, can produce two typical metapodial awls.

Treatment of the butt (condylar) end of the awl can take several forms: the entire condyle may be ground round, removing projecting condylar surfaces; the anterior-posterior surfaces of the condyle may be ground flat; the medio-lateral surfaces (interior and exterior sides of the condyle) may be ground flat or rounded, in combination with the first two treatments, or the condyles may receive no treatment. A metapodial awl occasionally is found with no condyle at all and with the metaphysis (growth center) as the butt. In such cases, a young animal was the tool source and the closing of the distal metapodial suture was incomplete; the cartilage between the epiphysis and metaphysis soon breaks down and the epiphysis is lost, leaving an awl with no butt (culturally altered) end.

Four round-ended metapodial awls were recovered from Antelope House; two had no condylar ends and one was ground flat on all surfaces. A hole was pierced (not drilled) through the condylar end of one awl.

Lengths of metapodial awls ranged from 129 mm to 41 mm, averaging about 80 mm.

Types of Points

Metapodial awls, as well as splinter awls, can be grouped into two major types: those with abruptly tapering (robust) points and those with continuously tapering (fine) points. Robust points generally are characteristic of awls 15 mm or more in width, fine points of those less than 15 mm wide. Due to the characteristic of the condyle in metapodial awls, most awl shafts are more than 15 mm wide, so that it is not surprising that only three of the awls with discernible point types could be classified as fine points.

Use Length

Of the 45 metapodial awls in which use length was visible or could be accurately estimated, only 18 measurements were obtained. Such problems as high polish, broken points or broken shafts eliminated the balance of the artifact sample. Average use length is 9.4 mm, with a maximum of 24 mm and a minimum of 6 mm. Thirteen metapodial awls have chipped or broken points. An awl recently manufactured from fresh bone would be more resilient than the artifact as we study it. It is my opinion, therefore, that chipped and broken points are the result of activities other than basketmaking, such as chert knapping.

Wear patterns on points suggest an in-and-out piercing motion, as one might expect in the manufacture of baskets. The metapodial awl, with its wide shaft and rectangular cross section, would allow for easy passage of the vegetal splint to the other side of the basket.

Provenience Associations

No concentrations of metapodial awls could be discerned. Kivas B and C and Room 47 each yielded two awls. The South Plaza yielded seven awls, but in no concentrated pattern. Other proveniences generally yielded only one awl each.

Metapodial awls are most numerous in Late PIII, which has 17 specimens associated with it. As with reusable resources, metapodial awls from earlier occupations can be resharpened, used and redeposited in later proveniences. Population increases would increase the number of awl users and, consequently, the number of awls produced in a given period.

Twenty-seven percent (n = 12) of the metapodial awls are burned. The reason for this is open to speculation.

Metapodial-Type Awls

In this category, one can place those awls with articular heads, but which are not true artiodactyl metapodials. Of the eight awls from Antelope House in this category, six are made from *Canis* sp. (domestic dog or coyote) and one each from turkey and jackrabbit (Table 201).

Average use length in this category is 12.75 mm, with a maximum of 23 mm and a minimum of 7 mm. These figures should not be correlated

Table 201. Sources of metapodial-type awls.

	Humerus (Distal)	*Radius*	*Tibia*	*Femur (Proximal)*	*Femur (Distal)*
Turkey	1	—	—	—	—
Jackrabbit	—	—	1	—	—
Dog/Coyote	—	2	2	1	1

with other awls, since they represent only four awls with visible wear patterns.

Modification by grinding the articular head occurred in four of the eight awls. Six awls in this category may be designated as fine-point awls. One of the awls had been burned.

No concentrations of this awl type are seen. Rooms 21 and 29 each yielded one specimen; splinter and true metapodial awls were recovered in greater than expected quantities from these rooms. Dates for these awls range from PII to Late PIII; some are assigned to mixed categories, yielding little behavioral information. Metapodial-type awls probably were used in basketry manufacture.

Ulna Awls

Ulna awls resemble metapodial awls, in that the articular head is usually retained as a butt or handle. The 15 ulna awls recovered from the animals of medium size (gray fox, 1; dog or coyote, 1; bobcat, 1) and from the larger artiodactyls (deer, 3; antelope, 1; bighorn sheep, 2; unidentified artiodactyl species, 6).

Ulna awls probably are basketry tools, as are splinter awls and metapodial awls. Lengths vary from 160 mm to 58 mm, with an average of 95.5 mm. Use length averages 13.4 mm.

No concentrations of ulna awls were found. Most dated awls are from Late PIII. Six of the awls have chipped or broken points, again indicating heavy use, perhaps as stone flakers.

Scraping Tools

Scraping tools are characterized by ground surfaces with striated or highly polished wear patterns. Those recovered from Antelope House may be placed in two categories: (1) tools for the preparation of plant fibers, and (2) hide-working tools.

Plant Fiber Scrapers

The first category contains a large and diverse assemblage of tool types. The tools were made from artiodactyl elements which, owing to thicker shaft cortices, are better able to withstand the pressures of scraping than are smaller mammal or bird bone shafts.

The following types are designated plant fiber scrapers: humeri "fleshers," shaft scrapers, rib scrapers, and innominate scrapers. In an experimental study in the preparation of yucca fibers, Osborne (1965) found the so-called humerus flesher to be the tool best suited for fiber preparation.

Three humeri scrapers were recovered from Antelope House; all are left humeri. Pronghorn contributed two scrapers; the third, a tool blank, is probably from a mule deer.

Of the same configuration as the humeri scrapers are two smaller scrapers manufactured from the proximal phalanges of antelope. The working edge is ground from the proximal epiphysis of the phalanx. The smaller scrapers possibly were used on small delicate fibers, such as narrow-leaf yucca. One comes from the Late PIII North Trash (P624), the other from Early PIII Room 29 (P 1318), Floor 5.

Scrapers made from longbone shaft fragments of artiodactyls also were examined. Characteristic transverse striations on one edge form the rule, but one specimen has two worked edges. Tibia, humerus and femur shafts are the sources of the six specimens examined. Their proveniences are north area (P 1054), PII Room 1 (P 1304), Middle PIII Room 21 (P 344), Late PIII Room 22 (P 1192), Late PIII Room 23 (P 1404), and Late PIII Kiva B (P 219).

Rib scrapers (n = 25) have either one or two working surfaces. Wear patterns suggest a vertical orientation of single-edged end scrapers; that is, they may have been held upright in a clenched fist. Sixteen rib scrapers utilized either

the proximal or the distal end of the shaft. The average width of the working surface is 17.8 mm. Lengths of these scrapers vary from 143 mm to 56 mm. Four scrapers utilized both the anterior and posterior edges, and three utilized both the proximal and distal ends. Only one rib scraper utilized the posterior edge alone. Wear surfaces vary from 163 mm to 29 mm, the average being 74.1 mm in those utilizing anterior-posterior edges.

Only one example of an innominate scraper was recovered from Antelope House. It is the anterior (ilium) end of a left innominate, the edges of which are ground flat. The inferior border is the working edge. It is from the Middle PIII South Plaza (P 123).

Hide Scrapers

Scrapers in the hide-working category characteristically have wide working areas and exhibit a high degree of polish and very fine striations on their working edges.

One type of hide-working tool is the mandible scraper. Deer mandibles are the sources of these tools; represented are five lefts, two rights and one indeterminate fragment. The fragment dates to BMIII Structure 71 (P 1114). Five tools date to Late PIII: one from the North Trash (P 097), two from Room 47 (P 1151), one from Room 5 (P 1120), Floor 1, and one from Room 23 (P 1406), Floor 1. The remaining mandibles are not dated.

Preparation of this tool involves removing the teeth, presumably because the dorsal surface (where the teeth are located) is the area held by the user; the ventral border is the scraping surface. Teeth can be removed by pulling out the entire tooth or by chipping the crown down to the roots. Evidence of wear from handling is shown on the roots of teeth in the mandible from Room 5 (P 1120). Further treatment of the mandible may involve rounding off the ascending ramus near the nutrient foramen.

Heavy striations on the side of the mandible from Room 23 suggest heavy grinding, which probably is not due to hide preparation. The anterior end of a mandible from Room 46 (P 608) is beveled and may have been used as an awl, as well as a scraper.

The degree of wear varies on ventral surfaces. All exhibit polish and very fine transverse striations. Wear on the mandible from Room 5 is so severe that the cortex of the bone has been worn through to the medullary cavity.

Ulna scrapers also were recovered. Only one antelope ulna from the South Plaza (Early PIII, P 1204) can be accurately termed a scraper, but it is too fragmentary to measure use length and other dimensions. Two other ulnae can be classified as scrapers. Their proveniences are Kiva C (P 292), Middle PIII artiodactyl, and South Plaza (P 123), Middle P III deer.

Flakers

Twelve implements fall into the category of flakers. Flakers are characterized by blunt or faceted points and usually are elements of deer antler, as are nine of the Antelope House flakers; three are made from artiodactyl metapodial shafts.

The natural tine tip of a deer antler is the working end of an antler flaker. Antler flakers were used to pressure flake chipped stone tools, such as projectile points and knives. In the process of pressure flaking, the point of the antler becomes very dull, making it faceted and useless; in order for the flaker to be efficient, its user must grind off the facet(s). Also characteristic of antler flakers are occasional cutting striations in the handle area. These are formed when the user draws the antler handle across the freshly flaked lithic surface, removing very fine stone edges and yielding a better flaking surface. Two Antelope House antler flakers exhibit these cutting striations.

Eight of the nine antler flakers have measurable circumferences in the working area. The average circumference is 9.75 mm, with a maximum of 17 mm and a minimum of 6 mm.

The lengths of antler flakers vary greatly. Because antler is especially susceptible to weathering and to rodent gnawing, not all antler flakers are complete tools. Average length is 76.25 mm, with a maximum of 125 mm and a minimum of 36 mm (a fragment).

Five antler flakers had recently been resharpened, as indicated by grinding striations on their beveled points. Only two flakers have any degree of polish, indicating prolonged use as a tool.

Metapodial flakers (n = 3) are characterized by very blunt, sometimes chipped points. Two specimens have well developed flaking facets. Striations on the point edges and shafts of these

flakers indicate prior use as metapodial awls. Two flakers are from Room 21 (P 329, Late PIII, and P 361, Middle PIII). The other is from the North Trash and is dated Late PIII.

Bone Tubes

Bone tubes characteristically are manufactured from the longbone shafts of the medium-size fauna represented at Antelope House, including jackrabbits, dogs and large birds. Table 202 describes the species and elements represented by each of the 20 bone tubes recovered.

Owing to grinding of the wing bones (ulnae) of birds, which obliterates the scars of secondary feathers, some specific categories cannot be determined. Longbone midshafts are, as a rule, devoid of features that can be used as a key to the taxa of the individuals. Grinding and polishing of bone tubes further removes visible features. It is for these reasons that general categories (e.g., "large avian, probably eagle") must be included in the analysis.

The sawed ends of bone tubes were ground flat and polished. The exterior cortex of the bone also was highly polished. The function of bone tubes at Antelope House is probably decorative. Several tubes might be strung together as beads in a necklace, for example. One intact example from Late PIII, Room 21 (P 308, FS 140), might be a hair ornament; the bone is an ulna (hawk) and is strung on a fiber twine. The twine is tied close to the surface of the bone at the midpoint of the 63-mm tube. Rising from the knotted area is a 30-mm segment of the same twine, which is tied to a small wooden twig 51 mm in length. The twig could be inserted into a hair braid or coil, where it would act much as the holding mechanism for an old style man's pocket watch chain.

The average length of bone tube material is 38.2 mm, with a maximum of 64 mm and a minimum of 12 mm. Widths vary from 5 mm to 14 mm, the average being 9.9 mm.

Kivas A and C, Kiva B Annex, and Room 47 each yielded two bone tubes. Others were randomly distributed across the site. Bone tubes are distributed temporally as follows: PI, 3; Early PIII, 1; Middle PIII, 3; Late PIII, 6 and PIII (general), 1. Other bone tubes (not discussed here) were recovered from proveniences of indeterminate date.

Weaving Tools

Two tools of unknown function may be weavers' tools. One Late PIII specimen recovered from Kiva B (P 218) is made from an antler beam splinter. It is cylindrical (119 mm long by 8 mm) and is rounded at both ends. Wrapped at its midsection is a sinew, which holds a leather thong fragment; a slight bow in the tool suggests that an object of some weight was suspended from it. Its kiva provenience might suggest a loom structure association.

The second tool comes from Room 1 (P 1313) and is dated PIII. It is the bone shaft of a large animal and measures 132 mm by 22 mm by 4 mm. A gentle curve in the blade suggests its use as a batten, a tool used by weavers to beat down wefts.

Gaming Piece

Six of the 15 gaming pieces recovered are from the South Plaza area. Dates from proveniences containing gaming pieces are not solid and little can be said about time of manufacture or of use. Their occurrence in the South Plaza area may indicate that games using these bone chips were played in the open.

Gaming pieces, or dice, usually range in length from 20 mm to 35 mm (two specimens), in width from 8 mm to 13 mm, and in thickness from 2 mm to 5 mm (averaging 3 mm). The pieces usually are oval, although one is diamond-shaped. Twelve are plain and three have decorations of various kinds (striations, paint, parallel lines and cross-hatching) on one side only.

The pieces were made from large mammal bone shafts. Blanks (two specimens examined) were ground flat on each side and then ground to the desired shape. Incisions or other decorations were added after preparation of the blank.

Hoof Tinklers

Two drilled artiodactyl hooves were found at Antelope House. The first, a right hoof sheath from Middle PIII Room 21 (P 345), was drilled through both sides of the posterior hoof surfaces and closed with a seam along the posterior edge. A hoof would stay open naturally, allowing for the width of the terminal phalanx. One way to close a hoof and to create such a seam is by

boiling the hoof to make it pliable and then binding or molding until dry.

The second hoof (also a right) is drilled through its distal point. Presumably, a knotted cord for suspension of the hoof was inserted through the hole. This artifact was found in the South Plaza (Provenience G1 44 304) and dates to Late PIII.

An unaltered right hoof also was examined. It is from Room 32 (P 730 mixed with F1 44'122) and dates to Late PIII.

Hoof materials may have been strung together to form rattles or "tinklers," objects used by many modern Indian groups. Such items would be categorized as ceremonial items and would be used in dancing or other nonutilitarian functions.

Ornaments, Pendants, Etc.

Four objects were manufactured from the sheaths of bighorn sheep horns. Two are most probably fragments of horn paddles destroyed by rodent gnawing, which is evident on their outer surfaces. A third, from Late PIII Kiva B (P 218), is a circular amulet of horn, measuring 43 mm to 50 mm in diameter. Its edges have been ground. The fourth horn object is the last 150 mm of the distal end of a left horn. It is unaltered, except for a 5-mm hole drilled in its distal point. It probably was used for decoration, as there are no visible wear or polishing marks.

An object made from the distal one-third of an artiodactyl tibia may be classified as "ceremonial." The distal epiphysis was ground round and two holes were drilled through the distal inferior condlyar surfaces. The shaft of the bone is highly polished. Its dimensions are 90 mm by 27 mm by 19 mm. Its function is unknown.

A fragment of a carved head (bird?) of bone was recovered from Room 29 (P 1321) and dates to PII. It is completely black, possibly due to application of a mineral stain. Its fragmentary nature suggests its attachment to a larger object, perhaps the rest of its body.

Three bone discs or circular pendants manufactured from the thin blade areas of mammal scapulae were recovered. From Room 30 (P 1159, Middle PIII) came a disc 23 mm in diameter; from the North Area (P 641, no date) came a drilled circular pendant 32 mm in diameter, with a 2-mm hole drilled 3 mm from the edge; and from Room 42 (P 254, Late PIII) came a drilled circular pendant 45 mm in diameter, with a 2-mm hole drilled 5 mm from the edge. These discs are approximately 1 mm thick and are finely polished.

Possible sources of these ornaments also were examined. Two incised scapulae from Central Plaza B (P 226, Late PIII, and P 760, mixed dates), in various stages of cutting, were examined. Rectangular blanks were cut away and were later ground into circles and drilled. Central Plaza may be a special work area for producing such discs.

Two possible hairpins, one of antler and the other of metatarsal shaft, were recovered from the Tower Corridor (P 1507, Middle PIII) and from Room 21 (P 338, Middle III). Length (140 mm and 155 mm) and fragility are the criteria for placing these items in this category.

One rectangular object (an ornament blank?) manufactured from a probable turkey tibiotarsus shaft was found in Room 7 (P 640, Late PIII).

Other Objects of Bone, Horn and Antler

One complete paddle of horn, possibly from a bighorn sheep, was found in Central Plaza (P 216, mixed dates). A residue of pitch and sand adheres to parts of the tool. Dimensions are 266 mm by 50 mm, tapering to 15 mm by 16 mm. A paddle fragment (handle end) was recovered from the South Plaza (P 122, Late PIII). This fragment is similar to that found in the Central Plaza. The function of this tool may have been ceremonial; the pitch covering may indicate utilitarian use as a pitch spatula or the former presence of an inlay of stone or shell.

Three awls which do not fit categories previously mentioned should be discussed here. One, a horn awl made from the tip of the horn sheath of an antelope, was recovered from the South Plaza (P 185, no dates). It would seem to fit into the metapodial awl class were it not made of horn. It is the only antelope horn material found at Antelope House.

The second awl is fine-pointed and made from the rib of an animal about the size of a dog. It is an unusually finely made awl; it is highly polished and very slender (65 mm by 7 mm by 2 mm), with a use length of 11 mm.

A very sharp antler implement may have been an awl or a dagger. It definitely is not a flaker, since it has striations running longitudi-

nally with the shaft. It is from Room 21 (P 338, Middle PIII) and measures 197 mm by 19 mm.

Three possible antler hammers or batons for working stone were examined. Characteristically battered on one end, these tools were struck with hammerstones or antler hammers to remove blades from prepared lithic cores. They were recovered from Kiva B (P 218, Late PIII), South Plaza (P 124, Early PIII), and Room 23 (P 1403, Late PIII).

Artifacts From Floor Contact Proveniences

Only one tool from the Basketmaker III period, a robust-pointed awl found on Floor 1 of Structure 71 (P 1115, FS 1378), falls into this category.

Pueblo II tools in this category were recovered from two proveniences. A possible weaving tool and a worked bone chip come from Room 1, Floor 5 (P 1313, FS 2082). The weaving tool is heavily polished on all surfaces. Similar tools of wood are used with modern looms as a batten for tamping the weft. From Room 76, Floor 1 (P 1224), came a splinter awl fragment.

Early PIII worked bone comes from only one floor contact provenience: Room 29. Floor 4 (P 1294) yielded one fragment of a splinter awl; it is polished, with transverse striations from the manufacturing process on the shaft, edges, and point. Floor 5 (P 1318) yielded three worked bone implements. The first, a fine-pointed metapodial awl, is unusual: a hole apparently was pierced (not drilled) through the epiphysis, or butt end. Wear polish on the point indicates heavy use. Polish on the shaft from handling also is heavy. The second, a proximal phalanx of an antelope, was ground to form a "flesher," which actually was used as a plant fiber scraper. This tool is highly polished from handling and from wear. The third, a bone tube (36 mm long) made from a jackrabbit humerus midshaft, was found. This ornament appears to be in the early stages of manufacture, as no polish is found on its outer surface.

Only one Middle PIII tool was found in a floor contact provenience. It is a metapodial awl found on Floor 3 in the Tower Corridor. It probably has been recently manufactured, as little polish is seen on the shaft. The transverse striations on the point and shaft had not been obliterated by wear or by handling.

Thirty-one artifacts were recovered from floor proveniences dated to Late PIII. Proveniences and descriptions are listed in Table 203. Except where otherwise noted, implements are made of deer bone.

Table 202. Sources of bone tubes.

	Humerus	*Ulna*	*Radius*	*Femur*	*Tibia*	*Indeterminate*
Buteo sp. (hawk)	—	2	—	—	—	—
Large avian, probably eagle	—	3	—	—	—	—
Meleagris gallopavo (turkey)	—	2	—	—	—	—
Large avian/medium mammal	—	—	—	1?	—	1
Lepus californicus (jackrabbit)	1	—	1	2	1	—
Canis spp. (dog/coyote)	2	—	—	3	—	1

Table 203. Late Pueblo III bone artifacts from floor contact proveniences.

Provenience	*Type*	*Description*
Room 1, P 317, Floor 2	Worked bone fragment	Straited, function unknown.
Room 5, P 1120, Floor 1	Mandible scraper	Highly worn and polished. Crowns of teeth removed culturally. Function: hide dressing tool?
Room 5, P 1120, Floor 1	Splinter scraper	Weathered longbone fragment. Edges ground, striations visible. A fiber working tool.
Room 5, P 1120, Floor 1 Inside fireplace	Splinter awl	Very highly polished, sharp, robust point. Manufacturing striations obliterated by use.

Continued

Table 203. Late Pueblo III bone artifacts from floor contact proveniences—Continued

Provenience	*Type*	*Description*
Room 5, P 1120, Floor 1 Inside fireplace	Metapodial awl	Robust point, highly polished. Butt end with shoulder. Three augered pits in internal surface of butt.
Room 5, P 1121, Floor 1	Splinter awl	Fine point, made from cottontail tibia (proximal 1/2). Point resharpened, butt end unaltered.
Room 5, 1121, Floor 1	Gaming piece	Roughly circular, diameter 18 mm. Lack of polish, presence of manufacturing striations suggest this may be a rough blank.
Room 9, P 062, cc 1336, F.S. 50, Floor 1	Splinter awl	Fine point. Crudely made from non-prepared splinter of longbone.
Room 21, P 308, F.S. 140, Floor 1	Bone tube	Ulna shaft section from large hawk or turkey. Strung on yucca fiber.
Room 21, P 336, Floor 2	Splinter awl	Fine point. Butt end polished from handling. Edges ground. Point highly polished, manufacturing striations obliterated.
Room 23, P 1404, F.S. 2034, Floor 1	Splinter scraper	Wear pattern not visible as this tool was resharpened before deposition. Shaft polished.
Room 23, P 1406, Floor 1	Mandible scraper	Crowns of teeth broken off. Heavy wear patterns (striations) suggest multiple uses for this tool. Ventral surface polished.
Room 29, P 1173, Floor 2	Rib scraper	Single (posterior) edge utilized as tool. Probably a fiber working tool.
Room 38, P 507, Floor 2	Splinter awl	Fine point, incised from blank. Highly polished, with butt ground round.
Room 42, P 255, Floor 1	Splinter awl	Robust point. Probably well used, as striations from manufacturer are obliterated on point, but with no polish or wear on shaft.
Room 42, P 255, Floor 1	Metapodial awl fragment	Butt and shaft only. Polished and striated shaft. Rounded butt.
Room 43, P 596, Floor 1	Metapodial awl fragment	Odd in that proximal end of metacarpal is the butt end. Shaft striated; no point.
Room 50, P 630, Floor 1, F.S. 753	Splinter awl	Slender, tapering, fine point. Highly polished shaft and point. Wear pattern has nearly obliterated manufacturing striations.
South Plaza, Floor 1 F4 51 P 112	Gaming piece fragment	Roughly circular (21 mm diameter, 5 mm thick). Edges ground. Probably broken during manufacture.
South Plaza, Floor 1 F5 51, P 122 F.S. 1177	Paddle fragment	Bighorn sheep horn sheath paddle handle fragment. Beginnings of a drill hole on tapered end.
South Plaza, Floor 1 F5 51, P 122 F.S. 1178	Splinter awl	Robust point. Incised from blank. Butt ground flat. Shaft highly polished.
South Plaza, Floor 1 F5 53, P 122	Rib scraper fragment	Fragment only, with use length visible.
South Plaza, Floor 1 G1 54, P 122	Splinter awl	Made from longbone shaft fragment. Shouldered point like tang on a file. Highly polished, butt ground round, fine point.
Central Plaza, Floor 2 K453, P 220	Metapodial awl blank	Both distal condyles present are ground flat anteriorly and posteriorly.

Table 203. Late Pueblo III bone artifacts from floor contact proveniences—Continued

Provenience	*Type*	*Description*
Central Plaza Annex Floor 2 755	Rib scraper	Two surfaces as working edges. Probably a fiber working tool.
Tower Corridor Floor I3, F.S. 1061 13 54, P 263	Splinter awl	Fine point. Incised from blank. Butt rounded; point well worn; shaft with little polish.
Tower Corridor Floor 3 I1 55, P 263	Horn ornament	Distal end of sheath of bighorn sheep horn; drilled near distal end for suspension.
Tower Corridor Floor 4 F.S. 897 I2 55, P 264	Splinter awl	Very fine point. Incised from blank; resharpening has obliterated wear pattern. Slight polish.
Tower Corridor Floor 6 F.S. 417 I2 55, P 272	Splinter awl	Fine point ground flat. No wear pattern visible due to resharpening. Incised from blank, edges ground.
Str. 79, P 1516, Floor 1	Splinter awl	Made from distal half of jackrabbit tibia. Fine point. Polish obliterated by burning.
Str. 79, P 1516, Floor 1	Metapodial-type awl	Fine point. Made from shaft of tibia of jackrabbit. Point dull from heavy use. No polish.

Table 204. Bone artifacts of unknown date.

Provenience	*Type*	*Description*
Room 46, P 620, Floor 2	Splinter awl	A fine point awl now dull. Made from distal end and shaft of a *Canis* spp. radius. Butt ground flat. Highly polished.
Room 46, P 620, Floor 2	Metapodial-type awl	Very fine point awl made from the distal end of a turkey humerus. Distal end is butt, unaltered. Light wear, polish.
46, P 620, Floor 2	Splinter awl	Fine point awl from a turkey tibiotarsus shaft. Fine striations run the length of the tool.

No artifacts were found on floor proveniences in the Navajo period and none are classed in the mixed dates category. Table 204 lists artifacts to which no dates were assigned.

Conclusions

Due to the availability of workable bone, horn, and antler, the inhabitants of Antelope House created, used, and discarded a wide variety of bone implements. Most were manufactured from elements of food animals.

Subsistence changes, if any, do not seem to have drastically altered tool technology or the numbers of tools and other bone objects produced during the occupation of the pueblo.

Chapter 27

The Stone Artifacts

The analysis of stone artifacts from Antelope House reported here considers all floor contact items, as well as all items from the fill that fall into formal categories; that is, those items exhibiting some deliberate modification prior to use. Of the 3062 items recovered, 1802 specimens, or 58.9 percent, were examined. The initial goals of this project were to identify and classify the artifacts, to identify raw material sources, to correlate tool types and to discuss possible social, inferences in the lithic data.

Method and Research Design

Identification and classification of artifacts was accomplished through microscopic analysis, using a 0.7 to 20.0 X (zoom) binocular microscope. Artifacts were classified on the basis of gross general morphology and microscopic use wear patterns. The typology was based on the experimental works reported by Crabtree (1972) and Tringham *et al.* (1974), as well as on previous analyses by Chapman (1973), Schaafsma (1977), and Linford (n.d. b; n.d. c).

Length, width and thickness of the chipped stone artifacts were measured with stainless steel slide calipers. Weight was measured on a three-beam balance. The length of an object was measured from the proximal end (the striking platform, if present) to the distal end, even if this axis proved shorter than the "width." The width of an object was always measured perpendicular to the axis connecting the proximal and distal ends. As the shapes of the items varied widely, it is not uncommon to find measurements for an object in which the "width" exceeds the "length." Thickness was measured perpendicular to the widest facet of the object, at 90° angles to the length and width. This measurement consistently represents the thickest portion of the implement. Weight was measured in grams.

The data were recorded on standard IBM data sheets, then punched and verified by personnel of the Research Support Section, University of Arizona Computer Center. Considerable effort was made to eliminate errors in the recording stage, and errors which became apparent during the initial computer manipulations were corrected. Although this does not mean that the data is error-free, it does mean that mistakes are minimal and should not adversely affect the data to any large degree.

Comparisons have, in some cases, been drawn between the assemblage from Antelope House and those from excavations at five other major sites in the Four Corners region: Pueblo Bonito (AD 777–1275) in Chaco Canyon (Judd 1954), Mug House (AD 736–1270) at Mesa Verde (Rohn 1971), Big Juniper House (AD 752–1062) at Mesa Verde (Swannack 1969), Badger House (AD 900–1258) at Mesa Verde (Hayes and Lancaster 1975), and Tse-ta's (PI–PII) in Canyon de Chelly (Steen 1966). The purpose of the comparisons is not to suggest any connection or communication between the sites, but to emphasize the similarity of stone artifact assemblages among six relatively contemporary Western Anasazi pueblos.

For the identification of raw materials, I relied on *Dana's Minerology Handbook* (Hurlbut 1971) and was aided by personnel of the Department of Geosciences, University of Arizona, and of the Arizona Bureau of Mines. Location of raw material sources involved a reconnaissance of Canyon de Chelly National Monument by the author prior to the analysis and was aided by data recorded by the Canyon del Muerto Survey. This reconnaissance also shed light on the availability of local resources, their relative quality, and the form in which they are available.

The original research design called for determining, through the testing of hypotheses, the extent to which these criteria affected manufacturing techniques and artifact form and style.

Hypothesis A: A low availability of high quality raw material has a direct effect upon artifact manufacture and use.

Test Implications: (1)Only those items manufactured from higher quality materials show retouch; (2) a significantly higher level of use edges per artifact on higher quality materials; (3) a significantly lower percentage of unutilized flakes in the categories of material considered to be of higher quality; and (4) a significantly lower percentage of extant cores, possibly accompanied by an increase in core nuclei and a general decrease in measurements of the cores of higher quality raw materials.

Hypothesis B: The form in which a raw material is available will have a direct bearing upon the form and style of artifacts produced.

Test Implications: (1) The smaller the parcels of parent material in its natural state, the smaller the artifacts produced from them, and (2) those artifacts produced from materials available primarily in tabular or blocky form will be tabular or blocky in form, and often will show more cortex on the finished artifact, owing to the difficulty of removing it.

It was suspected that significant correlations between artifact function and raw material would appear, based on statistical manipulation of the computerized data.

Hypothesis C: Certain specific raw materials were preferred in the manufacture of a given artifact type, and/or preferred for use in a given activity.

Test Implications: (1) When more than one raw material is equally suited for the manufacture of a tool or the performance of a chore, a single material or group of materials is selected signficantly more often than the others; (2) among parent materials equally suited for a particular chore, a significant portion of those selected is of similar color or coloration; and (3) a significant portion of all specimens of a particular raw material is used for the same or similar functions when other equally abundant and equally suited materials are available, but they are used to a lesser extent.

It was hoped that artifacts made of materials known to be exotic to Canyon de Chelly would appear in forms and shapes also exotic in comparison to the rest of the assemblage. Should this be so, more accurate approximations of material sources (and trade routes) might be developed through comparison with excavation data on sites contemporary with Antelope House.

The final goal of the project (to discuss possible social inferences in the lithic data) is the most difficult. All procedures in this aspect of the analysis were carried out under the assumption that all material culture reflects, to some extent, the past behavior of human populations (Schiffer 1976). If this is so, then the lithic assemblage, when properly studied, should illustrate certain patterns of behavior among the creators and users of that assemblage.

Hypothesis D: The distribution of lithic artifacts may reflect preferential use of space, specific activity areas and/or tool kits.

Test Implications: (1) Significant differences in the distribution of artifacts associated with the five stages of the use life of an artifact (procurement, manufacture, use, maintenance and discard); (2) clustering of artifacts with similar or identical functions; (3) like artifacts not clustered, but recovered from similar or identical loci within the pueblo; (4) clusters of unlike artifacts repeatedly recovered, so that a comparison of the clusters shows a low variance (indicating high similarity), and (5) differential density of artifacts in various loci.

The next hypothesis, concerning residence units, depends heavily upon nonlithic excavation data and on a number of assumptions: (1) a residence unit consists of a series of contiguous rooms in horizontal and/or vertical association

and presumably was occupied by a single nuclear or extended family; (2) all families performed the same general day-to-day activities, using similar assemblages of tools with similar concepts of space utilization; (3) all families had similar concepts of curation and discard; and (4) based on supportive data from Hypothesis D, each room in a residence unit will have been the scene of specific activity (such as sleeping, milling, cooking and storage).

Hypothesis E: The lithic assemblage can be used to verify postulated residence units based on architectural data and other excavation data.

Test Implications: (1) Tests of variance show lower results (indicating more similarity) in comparisons of the artifact complexes in sets of rooms suspected of comprising residence units than in comparisons of the artifact complexes of sets of randomly selected rooms; and (2) the assemblage of each proposed residence unit varies sharply from room to room in such a manner that each room within a unit exhibits an artifact complex comparable to a room in every other unit.

Hypothesis F: If the residents of Antelope House had differential access to resources (indicating possible social stratification), this will be reflected in the lithic assemblage.

Test Implications: (1) In comparisons of contemporary rooms or residence units, a significant portion of the higher quality materials is limited to a small portion of the population (as indicated by distribution); (2) beyond the realm of preferential use (Hypothesis C), a wide range of artifacts in specific rooms or residence units show an inordinantly high incidence of particular raw materials when compared with similar materials; (3) large assemblages of specific parent materials in raw or bulk form (cores, usable but unutilized flakes) recovered from individual rooms or residence units; and (4) significantly unequal distributions of exotic raw materials not explainable by preferential use (Hypothesis C).

Hypothesis G: Within the population of Antelope House, certain individuals may have been more talented than others in carrying out selected activities involving the production and/or use of specific artifact types.

Test Implications: (1) Unusually large and uniform clusters of a single artifact type in various stages of manufacture (such as cores, flakes, preforms and finished items), with the finished items exhibiting similar style, technique, and size; (2) significantly large and uniform clusters of artifact types in various stages of use, maintenance, and discard (such as items with extensive use wear, items exhibiting resharpening, items worn down to unusable size, items showing reuse, and broken items), and (3) differential distribution of "tool kits," or groups of different artifacts associated with the same function (such as cores, hammerstones, core nuclei, and hard hammer flakes), in comparisons of residence units.

As I became more familiar with the data, it became clear that the original research design, as outlined above, would have to be modified. The most prominent change resulted from the fact that very few artifacts were found in floor contact proveniences. Although it is not certain that objects found in contact with a use surface actually were associated with that surface at any time during their use life, the chances are much higher that such an association is valid than if the analyst is dealing with artifacts from fill and/or known trash deposits. For this reason, the hypotheses dealing with possible social inferences (Hypotheses D, E, F and G) rely almost entirely upon floor contact artifact data, which are scarce. Because this is particularly true for Hypotheses D and E, those hypotheses were omitted from this study. Furthermore, statements dealing with Hypotheses F and G are, at best, tenuous, since they reflect patterns suggested, but weakly supported, by the data.

For this reason, emphasis was shifted to the technological aspects of the lithic assemblage, such as defining the artifact types and delineating methods of manufacture and use, as well as comparing the morphological characteristics with the assemblages from pueblo sites contemporary with Antelope House.

My analysis is descriptive. Each item is extensively described according to a list of 46 variables, each variable having as many as 66 values. This data was computerized, each item (specimen) being equivalent to a single punch card.

The primary focus in classifying each item is function, as determined on the basis of microscopic analysis of use wear. For the chipped stone complex, this typology relies heavily upon the definitions offered by Crabtree (1972) and the

interpretations derived by Tringham *et al.* (1974) through experimentation. For the ground stone complex, I drew upon my own earlier work (Linford n.d. a; n.d. b). The concept of function as used here remains on a fairly general level and does not attempt to be as specific as Tringham's work. For instance, although it was determined whether an item showed cutting wear or scraping wear, no attempt was made to delineate the physical qualities of the material cut or scraped (meat, fruit, wood, root, etc.).

Further categorization in the classification process was dependent upon the various morphological characteristics of the item itself. These include size, shape, location of the utilized portion, number of utilized portions and shape of utilized portion on the artifact itself. (Each computation allowed for up to four utilized portions on any given item.) Although of less importance, the context in which the artifact was deposited also was considered in determining function.

On the basis of the above criteria, 66 types of ground stone artifacts and 51 types of chipped stone artifacts were defined. A complete listing of these artifact types and their relative quantities is presented in the following subsections. A glossary of lithic terms as used here concludes the chapter.

Raw Materials

The stone artifact assemblage from Antelope House is comprised largely of 26 varieties of stone: a twenty-seventh category, labeled "other," includes numerous, less common varieties (Table 205). Many of these categories are actually subclasses of a single type of rock, such as chert or chalcedony, and were recombined during some of the data manipulations (Table 206).

Most of the raw materials are available within a 10-km radius of the site. Although the sandstones have a wide range in grain size and density, it is virtually certain that they all derived from the upper three layers of the de Chelly sandstone through which the canyon has been eroded (Cooley *et al.* 1969; McDonald 1976).

The sandstones are capped by the Shinarump Conglomerate, comprised largely of a coarse gray sandstone and containing "cobbles of basaltic rock, quartzite, chert, and petrified wood" (McDonald 1976). All of these materials were used in the manufacture of tools at Antelope House. My limited reconnaissance of the North Rim and Black Rock Plateau showed that sufficient quantities of these materials are available in loose cobble form and could easily be procured simply by gathering; no quarrying is likely to have occurred. The cobbles are limited to the plateaus; a reconnaissance of the canyon floor at and around Antelope House failed to reveal any cobbles which might have eroded over the rim.

Although my reconnaissance did not include a systematic study of the size of the cobbles, most were approximately the size of a modern hardball. This is further supported by the overall dimensions of the cores and hammerstones recovered during excavations at Antelope House, although a few specimens of larger (softball size with cortex removed) were recovered.

With few exceptions, the raw materials are well suited to the functions for which the tools were used. The variations in cherts and chalcedonies range from poor quality (granular, imperfections, and impurities) to high quality (glassine, homogenious). With the possible exception created by the lack of obsidian in large counts, the raw material assemblage is equal in quality to those of several other puebloan sites with which I am familiar.

A number of the raw materials identified in the Antelope House assemblage are of unknown origin, but only one, obsidian, is known to have been imported. The exact location of the source of the obsidian is conjectural, but it probably is in the San Francisco Mountains, approximately 120 miles to the west-southwest. Other possible sources include the Jemez Mountains, about 140 miles to the east in New Mexico, and the lava flows between Gallup and Grants, New Mexico, approximately 80 to 100 miles to the southwest (Linford n.d. b). As only four specimens of obsidian were recovered, it does not seem likely to have been the object of large scale trade. This material was not sought for any specific function, as the four specimens recovered included an unutilized flake, a scraper, and drill, and a projectile point.

The raw materials for which the primary source remains ever more uncertain include coal, jet, hematite, turgite, limonite and calcium carbonate. The coal and jet specimens (four items) may have come from the San Juan region, approximately 80 miles to the north, or the Coal Mine Mesa area on the Hopi Indian Reservation,

Table 205. Overall raw material frequencies.

	Absolute Frequency	*Relative Frequency (Percentages)*
Granular Rhyolite	6	.3
Crystaline Rhyolite	4	.3
Chert	460	25.5
Chalcedony	118	6.5
Dark Brown Chert	2	.1
Gray Chalcedony with Red and Blue Inclusions	19	1.1
Chert with Quartz Inclusion	1	.1
Gray Chalcedony with Red Inclusions	52	2.9
Red and Gold Chert	18	1.0
Pink Banded Chalcedony	6	.3
Pink Chert with Gray Inclusions	3	.2
Red Chalcedony with Angular White Inclusions	14	.8
Black Chert	376	20.9
Obsidian	4	.2
Purple and Gold Chert	6	.3
Purple Chalcedony	12	.7
Red and Gold Chalcedony	15	.8
White Chalcedony	1	.1
Gold Chalcedony	2	.1
Quartz	3	.2
Quartzite	145	8.0
Basalt	26	1.4
Breccia	2	.1
Granite	9	.5
Gneiss	4	.2
Sandstone	202	11.2
Volcanic Sandstone	4	.2
Silt Stone	8	.4
Blue Sandstone	2	.1
Silicified Wood	127	7.0
Chalcedonized Wood	12	.7
Coal	1	.1
Calcium Carbonate	35	1.9
Chalk	2	.1
Talc	20	1.1
Jet	1	.1
Hematite	50	2.8
Limonite	9	.5
Malachite	3	.2
Ocher	1	.1
Turgite	3	.2
Other	4	.2
Sulfur	1	.1
Lepidolite	1	.1
Gypsum Crystals	8	.4
	1802	100.0

about 80 miles to the west. Hematite, turgite and limonite are closely related chemically (FE_2O_3, $HFeO_2$ and $2Fe_2O_3H_2O$) and occur under similar conditions, normally precipitating out of rocks with high iron content (Hurlbut 1971: 282, 304–305). The hematite recovered from Antelope House is the solid, dense, nodular form, while the limonite (or goethite) and turgite are earthy to silty in composition. Colton (1960: 86) mentions the economic value to the Havasupai of a source of "powered" hematite (or possibly turgite) in the Grand Canyon. It was a popular trade item to the Hopi. Don P. Morris (1977: personal communication) has located a cave with exten-

Table 206. Adjusted raw material frequencies (excluding 613 beads and pendants).

	Absolute Frequencies	*Relative Frequencies (Percentages)*
Rhyolite	10	.8
Chert	363	30.5
Obsidian	4	.3
Quartz	3	.3
Quartzite	143	12.0
Basalt	26	2.2
Breccia	2	.2
Granite	13	1.1
Sandstone	209	7.6
Silicified Wood	227	23.3
Calcium Carbonate	35	2.9
Jet	1	.1
Malachite	3	.3
Pigment	63	5.3
Other	37	3.1
Total	1189	100.0

sive deposits of turgite in the Grand Canyon, approximately 145 miles from Antelope House. However, a spring in upper Canyon del Muerto near Mummy Cave was noted as being red in color, and such springs often are the force creating limonite and turgite, as well as some varieties of earthy hematite.

Although the limonite and turgite were used solely as "ocher," or pigment materials, the hematite specimens were used in axes, mauls, pigment, a stone disk, and stone balls (possibly grinding/hammerstones); six specimens exhibit no modification or wear. The wide variety of nondescript uses and the relative abundance (calculated by number of specimens and bulk) leads me to suggest that the hematite was locally available.

The final raw material of note is calcium carbonate. Always occurring in tabular form approximately 2.5 mm in thickness, this material was almost universally used for a single function or set of functions, which resulted in a single highly polished surface with striations radiating in all directions. The obverse surface also is flat, generally unaltered, but lightly ground. This material is rare in contemporary sites, as are the tabular polished stones made from it. Don P. Morris (1977: personal communication) reports that a likely source of this material is to be found along Chinle Wash just east of the town of Chinle. Personnel of the Arizona Bureau of Mines note that the entire plateau in which Canyon de Chelly lies is likely to contain such raw materials as this. I have also seen it in abundance along the west slopes of the Defiance Plateau.

With the exception of the polished tabular pieces of calcium carbonate, no lithic artifact types of an "odd" or exotic nature were recovered.

Chipped Stone Complex

As might be expected, preferential use of materials was most obvious when comparing the chipped tool complex with the ground tool complex. Miscellaneous chert was the most common category of material employed in the chipped stone industry (Table 207), accounting for 32.7 percent of the raw materials. Miscellaneous chalcedonies comprised 19.9 percent of the chipped tool assemblage, but was only the third most common variety. The second most commonly used material was a group of varieties of petrified wood, including silicified wood, chalcedonized silicified wood, gray chalcedony with red and blue inclusions, gray chalcedony with red inclusions, red and gold chert, purple and gold chert, purple chalcedony, red, gray and gold chalcedony and gold chalcedony. Together, these varieties comprise 27.9 percent (161 specimens) of the chipped stone assemblage. It is likely that a number of the specimens counted as miscellaneous chert and chalcedony actually are pieces of petrified wood, so that petrified wood might well be the single most commonly used material at Antelope House.

Materials of unusual or striking coloration were noted early in the analysis. It was suspected that these were varieties of silicified wood, but it was not until the analysis was nearly complete that these suspicions were confirmed by the discovery of pieces of identical coloration bearing cortex in the form of bark.

Approximately 65 percent of the cherts are unutilized flakes. The largest concentration showing utilization is the 10.4 percent used as cores, followed by 9.2 percent used as projectile points, and 8.2 percent used as knives. A surprisingly low 2.8 percent were used as scrapers.

After combining the various subtypes of raw materials into the smallest number of types possible for cross-tabulations (see Table 208), chert (comprised of various cherts and chalcedonies from Table 207), quartzite and chalcedonized

wood (including all those classes listed above) proved to comprise 93.8 percent of the total chipped stone assemblage.

Chert is the most common raw material in these tabulations, comprising 55.2 percent of the chipped assemblage. However, indications are that this material was not the most desirable for any particular function. Approximately 65 percent (204) of the chert specimens are unutilized flakes. The largest portion of cherts showing utilization is the 10.4 percent (33 specimens) used as cores, followed by 9.2 percent (29) used as projectile points and 8.2 percent (26) used as knives.

Chalcedonized wood, on the other hand, is a material of higher quality, as seen in its finer crystalline structure and more homologous nature. Although it is the second most common material in the chipped stone complex, only 52.9 percent (99 of 187 specimens) are unutilized flakes. Furthermore, 12.8 percent (24 specimens) are cores, 10.7 percent (20) are projectile points, 11.8 percent (22) are knives and 4.2 percent (8) are scrapers. In every category, the percentage of utilized chalcedonized wood surpasses that of the cherts.

Quartzite, although the third most common raw material in the chipped stone complex, (59.9 percent or 34 specimens) shows a very low percentage of utilization. More than 82 percent (28) of these specimens are unutilized flakes. Of those utilized, 8.8 percent (3) were used as knives. 5.9 percent (2) as cores, and 2.9 percent (1) as a scraper.

The above data suggest that the combined varieties of silicified wood constituted the most desirable raw material for chipped stone tools at Antelope House. Further evidence of this is seen

Table 207. Raw material frequencies for the chipped stone complex.

	Absolute Frequencies	*Relative Frequences (Percentges)*
Granular Rhyolite	4	.7
Crystalline Rhyolite	3	.5
Chert	187	32.7
Chalcedony	114	19.9
Gray Chalcedony with Red and Blue Inclusions	19	3.3
Chert with Quartz Inclusions	1	.2
Gray Chalcedony with Red Inclusions	52	9.1
Red and Gold Chert	18	3.1
Pink Banded Chalcedony	6	1.0
Pink Chert with Gray Inclusions	3	.5
Red Chalcedony with Angular White Inclusions	14	2.4
Black Chert	4	.7
Obsidian	4	.7
Purple and Gold Chert	6	1.0
Purple Chalcedony	12	2.1
Red, Gray and Gold Chalcedony	14	2.4
White Chalcedony	1	.2
Gold Chalcedony	2	.3
Quartzite	34	5.9
Basalt	4	.7
Gneiss	1	.2
Sandstone	3	.5
Volcanic Sandstone	1	.2
Silt Stone	1	.2
Silicified Wood	38	6.6
Chalcedonized Wood	12	2.1
Coal	1	.2
Talc	2	.3
Hematite	6	1.0
Limonite	1	.2
Other	4	.7
Total	572	100.0

in the fact that chalcedonized wood is the only material for which percentages in each use category surpass the overall percentage of the material in the total chipped stone complex. Chalcedonized wood comprises 32.7 percent of the total chipped stone complex, yet higher percentages of the knives (43.1 percent), the projectile points (37.7 percent), the cores (36.9 percent) and the scrapers (36.8 percent) were made from this material. Conversely, the proportion of unutilized flakes in this material (28.5 percent) is lower than the overall frequency. This is the only raw material for which this pattern holds true, as seen in Table 208.

Table 208. Cross-tabulation of raw materials and tool types.

Row Pct. *Col. Pct.* *Total Pct.*	*Cores*	*Chopper*	*Unutilized*	*Scrapers*	*Knives*	*Drills*	*Points*	*Flaked Axe*	*Unknown*	*Preform*	*Row Total*
Rhyolite	2.0	0.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
	28.6	0.0	57.1	14.3	0.0	0.0	0.0	0.0	0.0	0.0	
	3.1	0.0	1.2	5.3	0.0	0.0	0.0	0.0	0.0	0.0	
	.3	0.0	.7	.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Chert	33.0	0.0	204.0	9.0	26.0	5.0	29.0	1.0	7.0	2.0	316.0
	10.4	0.0	64.6	2.8	8.2	1.6	9.2	.3	2.2	.6	
	50.8	0.0	58.8	47.4	51.0	45.5	54.7	100.0	87.5	33.3	
	5.8	0.0	35.7	1.6	4.5	.9	5.1	.2	1.2	.3	55.2
Obsidian	0.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	4.0
	0.0	0.0	25.0	25.0	0.0	25.0	25.0	0.0	0.0	0.0	
	0.0	0.0	.3	5.3	0.0	9.0	1.9	0.0	0.0	0.0	
	0.0	0.0	.2	.2	0.0	.2	.2	0.0	0.0	0.0	.7
Quartz	2.0	0.0	28.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	34.0
	5.9	0.0	82.4	2.9	8.8	0.0	0.0	0.0	0.0	0.0	
	3.1	0.0	8.1	5.3	5.9	0.0	0.0	0.0	0.0	0.0	
	.3	0.0	4.9	.2	.5	0.0	0.0	0.0	0.0	0.0	5.9
Basalt	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.7
Granite	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.2
Sandstone	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.7
Silicified	24.0	1.0	101.0	8.0	22.0	5.0	20.0	0.0	1.0	4.0	187.0
Wood	12.8	.5	54.0	4.2	11.8	2.7	10.7	0.0	.5	2.1	
	36.9	100.0	28.6	40.0	43.1	50.0	37.7	0.0	12.5	66.7	
	4.2	.2	17.7	1.4	3.8	.9	3.5	0.0	.2	.7	32.7
Pigment	4.0	0.0	2.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	7.0
	57.1	0.0	28.6	0.0	0.0	0.0	14.3	0.0	0.0	0.0	
	6.2	0.0	.3	0.0	0.0	0.0	1.9	0.0	0.0	0.0	
	.7	0.0	.6	0.0	0.0	0.0	.2	0.0	0.0	0.0	1.2
Other	0.0	0.0	3.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	7.0
	0.0	0.0	42.9	0.0	0.0	0.0	57.1	0.0	0.0	0.0	
	0.0	0.0	.8	0.0	0.0	0.0	7.3	0.0	0.0	0.0	
	0.0	0.0	.5	0.0	0.0	0.0	.7	0.0	0.0	0.0	1.2
Column	65.0	1.0	353.0	20.0	51.0	11.0	55.0	1.0	8.0	6.0	572.0
Total	11.4	.2	61.7	4.9	8.9	1.9	10.3	.2	1.4	1.0	100.0

Ground Stone Complex

Just as certain raw materials were preferred for chipped stone tools, other varieties were found to be better suited for ground stone tools.

The largest unit in the ground stone complex is comprised of the tabular beads, of which there are 608 (49.4 percent). Of these, 229 are made of white chert and 372 of black chert. Nearly all come from a bracelet and necklace recovered from a single burial. In order to clarify the importance of the other raw materials, this overpowering unit (as well as five other beads, pendants, and preforms) was omitted from raw material tabulations for the ground stone complex (Table 209).

With the above revision, it may be seen that the most common raw material in the ground stone complex is sandstone, comprising nearly one-third (198 specimens) of all ground stone artifacts. This material is tremendously abundant in many colors and textures within the canyon itself and its rough surface textures makes it ideal for use in grinding tasks. Nearly 50 percent (101) of the specimens of sandstone were used as manos, grinding stones, etc., while another 21.6 percent (44 specimens) were incorporated into nether stones, such as ground slabs and metates. The remaining 30 percent was used in a wide variety of applications, most relating to the material's abrasive quality.

The second most heavily used raw material is quartzite, comprising 17.7 percent (109 specimens) of the ground stone complex. This material also was widely available, both in the canyon as river cobbles and on the plateau where it weathered out of the Shinarump Conglomerate. This material was used in a relatively unmodified form as hammerstones, 36.7 percent (40 specimens) being used for that purpose. Larger pieces, comprising 29.4 percent of the material (32 specimens), were formed into manos and less modified grinding utensils.

Table 209. Raw material frequencies for ground stone complex (excluding 613 beads of chert).

	Absolute Frequency	*Relative Frequency (Percentages)*
Rhyolite	3	.5
Chert	42	6.8
Chalcedony	4	.6
Dark Brown Chert	1	.2
Purple Chalcedony	1	.2
Quartz	3	.5
Quartzite	109	17.7
Basalt	22	3.6
Breccia	2	.3
Granite	9	1.5
Gneiss	3	.5
Sandstone	198	32.1
Volcanic Sandstone	3	.5
Silt Stone	1	.2
Blue Sandstone	2	.3
Silicified Wood	89	14.4
Calcium Carbonate	35	5.7
Chalk	2	.3
Talc	18	2.9
Jet	1	.2
Hematite	44	7.1
Limonite	8	1.3
Malachite	3	.5
Ocher	1	.2
Turgite	3	.5
Sulfur	1	.2
Lepidolite	1	.2
Gypsum Crystals	8	1.3
Total	617	100.0

Silicified wood was used nearly as often as the quartzite and accounts for 14.4 percent (89 specimens) of the ground stone assemblage. All but one specimen of the silicified wood (98.9 percent) was utilized in hammerstones.

Other materials comprising sizable percentages of the ground stone complex include hematite at 7.1 percent (44 specimens), chert at 6.8 percent (42 specimens) and calcium carbonate at 5.7 percent (35 specimens). The hematite was used as hammerstones (31.8 percent, 14 specimens), axes (13.6 percent, 6 specimens), for pigments (13.6 percent, 6 specimens) and smooth stone balls about the size of a modern hardball (11.4 percent, 5 specimens). A total of 91.5 percent (43 specimens) of the chert was used for hammerstones; 85.7 percent (30 specimens) of the calcium carbonate is in the form of small, rectilinear, highly polished slabs of unknown function.

As shown by the above data, the raw materials used in the ground stone complex, although diverse, show a series of distinct functions occurring most often within a given class of material. Thus, even more so than in the chipped stone complex, specific raw materials in the ground stone complex are related to specific functions.

Technology

The methods of procurement for the various raw materials appear to have been quite simple. It is reasonably certain that approximately 94.7 percent of the raw materials were acquired locally. It is doubtful that any required actual quarrying; most probably were collected. They appear to have been available in widely dispersed locations, rather than from central sources. Most of the raw materials used in the manufacture of chipped stone implements were easily collected as the cobbles of parent material weathered out of the Shinarump Conglomerate. The sandstones of the ground stone complex also were easily collected as tabular spurs sloughed off the walls of the canyon itself by weathering.

The Chipped Stone Complex

The chipped stone artifacts are made of silicious raw materials and were fashioned by the systematic removal of conchoidal flakes from the parent material. Fifty classes of implements were

Table 210. Artifacts comprising the chipped stone complex.

	Absolute Frequency	*Relative Frequency (Percentages)*
Unmodified	1	.2
Primary Core	20	3.5
Secondary Core	4	.7
Core Nucleus	32	5.6
Core-Hammerstone	6	1.0
Core-Scraper	1	.2
Core-Chopper	1	.2
Chopper	1	.2
Core-Knife	1	.2
Unutilized Flake	348	60.9
End Scraper	6	1.0
Side Scraper	5	.9
Double Side Scraper	1	.2
Scraper Fragment	7	1.2
Plane	1	.2
Knife-Scraper	7	1.2
Knife-Gouge	1	.2
Knife	42	7.3
Knife-Spokeshave	1	.2
Gouge	3	.5
Graver	2	.3
Drill Type III	3	.5
Drill Type IV	1	.2
Drill Fragment	1	.2
Drill-Knife	1	.2
Point Type I-A-2	2	.3
Point Type I-B	2	.3
Point Type I-C	1	.2
Point Type I-D	1	.2
Point Type II-A	5	.9
Point Type II-C-1	4	.7
Point Type II-C-2	1	.2
Point Type II-C-3	3	.5
Point Type II-C-4	3	.5
Point Type II-D	1	.2
Point Type II-Aberrant	2	.3
Point Type III-A	2	.3
Point Type III-B	1	.2
Point Type III-C	1	.2
Point Type III-D	1	.2
Point Type III-E	1	.2
Point Type III-Fragment	5	.9
Point Fragment	7	1.2
Point-Other Varieties	6	1.1
Point Preform	5	.9
Bifacial Knife	2	.3
Flaked Axe	1	.2
Unknown	7	1.2
Unusual Material	5	.9
Indeterminate Preform	6	1.0
Total	572	100.0

identified among 572 items. The relative frequencies presented in Table 210 are heavily skewed because all formal or retouched implements were analyzed, while only a sample of the utilized and unutilized flakes was examined. However, valid comparisons can be made between the various classes of formal artifacts. Certain other patterns involving the assemblage as a whole, yet independent of formal versus informal characteristics, may be pointed out.

As shown in Table 211, there is considerable evidence that most of the stone implements recovered from Antelope House were manufactured there.

The evidence is seen in the occurrence of large numbers of decortication flakes. The primary flakes (flakes with cortex completely covering the dorsal surface) comprise a relatively small portion of the assemblage. This is to be expected, for the cortex, although it covers the entire parent material, is quite thin (generally less than 0.5 mm) and comprises a very small portion of the total volume of a given nodule of parent material. The secondary flakes (those with cortex covering a portion of the dorsal surface) make up a much larger part of the assemblage, and these two varieties of cortical flakes when combined account for more than a third of all flakes examined. Such a high incidence of decortication occurring at the site would seem to dispel the theory that lithic craftsmen removed the cortex from a nodule of parent material at its location of discovery in order to reduce the bulk and weight for the trip home.

The majority of the tools from Antelope House are simply flakes used without benefit of prior modification (retouch). Of the 512 chipped stone items examined, 166 (32.4 percent) show use wear on one or more edges; of those, 85 specimens (51.2 percent) show no deliberate modification. However, this figure too is somewhat skewed by the nature of the sample analyzed. Since all formal artifacts (those showing deliberate modification) were selected for analysis and only a small portion of those without retouch were sampled, the actual percentage of unretouched utilized tools is considerably higher, possibly as high as 75 to 80 percent. Of the 80 specimens exhibiting both retouch and use wear, only 24 show unifacial retouch and 56 bifacial retouch.

Table 211. Flake typology.

Flake Type	*Absolute Frequency*	*Relative Frequency (Percentages)*
Primary Flakes	24	5.8
Secondary Flakes	124	29.8
Tertiary Flakes	248	59.6
Thinning Flakes	20	4.8
Total	416	100.0

Use wear is defined as "observable alterations of some portion of an artifact, which apparently occurred through utilization of that artifact as a tool" (Chapman 1977: 381). Sixteen varieties of use wear were identified on the 166 utilized objects. Tools often show wear on more than one edge (Table 212). One hundred sixty-six utilized items of the chipped stone complex exhibited 221 use edges, for an average of 1.3 edges per tool. Thirty-seven items (22.3 percent of those utilized) exhibit at least two use edges. Fourteen specimens (8.4 percent) have three or more use edges and four tools (2.4 percent) have four use edges. (This does not mean that 55 tools have multiple edges; those with three and four edges are included in the 37 items with two edges, etc.). As Table 210 shows, one tool could be used for two or more purposes, although that is not common. Only 10 artifacts (6 percent of the 166 utilized items) exhibit multiple use, in four combinations: knife-scraper, knife-gouge, knife-spokeshave and drill-knife. No instances were noted of more than two functions, and cutting was one activity noted on all of the bifunctional tools.

As shown by the figures in Tables 210 and 212, cutting is the most common task performed with chipped stone tools. Aside from unutilized flakes, the 48 knives are the most common tool listed in Table 210, and account for nearly 50 percent of the utilized specimens. Seventy-nine of the 221 used edges (35.7 percent) show attrition (Table 212), the wear most commonly associated with cutting (Chapman 1977: 386; Tringham *et al.* 1974). Edges thought to be worn, but upon which wear is indistinguishable from larger scale retouch, and those edges which show edge damage (that is, it is not certain whether the damage was caused by natural forces or by human use) make up 26.7 percent of the utilized chipped tools (59 specimens). The combined step fractures and unifacial chipping usually associ-

ated with scraping (Crabtree and Davis 1968: 426–428; Chapman 1977: 383; Tringham *et al.* 1974) comprise 19.5 percent (43 specimens) of the utilized tools. The categories indiscernible and abrasion refer almost exclusively to projectile point edges, the latter associated with manufacture rather than with use wear.

Previous studies have shown that it is not uncommon for an assemblage to show such overwhelming proportions of cutting tools in relation to scrapers (Linford n.d. a, n.d. b; Chapman 1977: 345–400, Tables 11.8 through 11.13), cutting tools commonly comprising 65 to 75 percent of utilized tools. The Antelope House figures may be skewed by the sampling technique, as previous analyses also have shown that the majority of utilized implements are used without benefit of retouch (Chapman 1971, 1972, 1977; Linford 1974, n.d. a), and the majority of these items were excluded from the Antelope House study.

The Ground Stone Complex

A sample of 1230 of these objects was analyzed for this study; these have been classified into 63 varieties based on morphology and use wear. The frequencies of these varieties are presented in Table 213.

Like the chipped stone implements, a number of these tools were used nearly or completely unmodified. Others were modified to various degrees prior to use. The sample of ground stone items analyzed includes all ground stone tools recovered, with the exception of a number of identifiable tabular fragments excluded because of time limitations. Thus the figures in Table 214 can be considered relatively complete and accurate, with the exception of the category "not present." Two artifact classifications have been omitted from the tabulations since inclusion of the massive counts in each would overemphasize those categories and would not allow meaningful comparison of the remaining artifact types. Omitted were 188 hammerstones (15.2 percent of all ground stone items), which are rarely, if ever, modified prior to use, and 613 beads and pendants (49.8 percent of all ground stone items), which are always refined to symmetrical forms.

The figures in Table 214 show that a maximum of 85.9 percent of the ground stone tools

Table 212. Absolute and relative frequencies of use wear in chipped stone tools.

Wear Pattern	*Primary Use Wear:* N/%	*Secondary Use Wear:* N/%	*Tertiary Use Wear:* N/%	*Quaternary Use Wear:* N/%	*TOTAL* N/%
Light Unifacial Step Fracture	13/7.8	4/10.8	2/ 14.3	0/0.0	19/8.6
Heavy Unifacial Step Fracture	11/6.6	3/8.1	0/0.0	1/25.0	15/6.8
Unifacial Chipping	5/3.0	2/5.4	1/7.1	0/0.0	8/3.6
Light Bifacial Attrition	32/19.3	13/35.1	7/50.0	3/75.0	55/24.9
Heavy Bifacial Attrition	15/9.0	7/18.9	2/14.3	0/0.0	24/10.9
Bifacial Percussion on an Edge	2/1.2	0/0.0	0/0.0	0/0.0	2/0.9
Percussion on a Surface	3/1.8	0/0.0	0/0.0	0/0.0	3/1.3
Light Rotary Chipping	6/3.6	0/0.0	0/0.0	0/0.0	6/2.7
Rotary Step-Fracture	1/0.6	0/0.0	0/0.0	0/0.0	1/0.5
Polish on a Faceted Edge	2/1.2	0/0.0	0/0.0	0/0.0	2/0.9
Edge Damage	23/13.9	4/10.8	1/7.1	0/0.0	28/12.7
Indiscernable	30/18.1	1/2.7	0/0.0	0/0.0	31/14.0
Crushing	0/0.0	1/2.7	1/7.1	0/0.0	2/0.9
Multidirectional Step Fracture	1/0.6	0/0.0	0/0.0	0/0.0	1/0.5
Abrasion	20/12.0	2/5.4	0/0.0	0/0.0	22/9.9
Rotary Striations	2/1.2	0/0.0	0/0.0	0/0.0	2/0.9
Total	166/99.9	37/99.9	14/99.9	4/100.0	221/100.0

Table 213. Artifacts comprising the ground stone complex.

	Absolute Frequency	*Relative Frequency (Percentages)*		*Absolute Frequency*	*Relative Frequency (Percentages)*
Grinding Stone	14	1.1	Notched Axe	6	.5
Grinding-Hammerstone	20	1.6	Axe Fragment	4	.3
Grinding-Hammerstone-Anvil	1	.1	Axe-Grinding Stone	2	.2
Round 1-Hand Mano	9	.7	Maul-Grinding Stone	1	.1
1-Hand Mano-Hammerstone	5	.4	Shaft Smoother	2	.2
Rectangular 1-Hand Mano	6	.5	Abrader	6	.5
Mano Type I	10	.8	Shaft Polisher	2	.2
Mano Type II-A	9	.7	Toy Axe	1	.1
Mano Type II-B	9	.7	Hoe-Grinding Stone	1	.1
Mano Type II-C	21	1.7	Hematite Pigment (dark red)	6	.5
Mano Type II-D	5	.8	Limonite Pigment (yellow)	6	.5
Mano Type II-F	1	.1	Other Pigment	3	.2
Mano Type III-A	19	1.5	Turgite Pigment (red)	2	.2
Mano Type III-B	4	.3	Pendant	1	.1
Mano Preform	2	.2	Tabular Bead	608	49.8
Mano Fragment	3	.2	Pendant or Bead Preform	4	.3
Mano-Pallet	5	.4	Tapered Stone Cylinder	2	.2
Mano-Mortar	1	.1	Stone Disk	13	1.1
Mano-Abrader	2	.2	Pot Lid	4	.3
Ground Slab	24	2.0	Tabular Knife	3	.2
Anvil	2	.2	Polishing Stone	17	1.4
Pallet	5	.4	Polished Stone	30	2.4
Mortar	4	.3	Polished Stone Preform	3	.2
Pestle	4	.3	Die	1	.1
Griddle	3	.3	Unknown	11	.9
Flat Metate	2	.2	Unidentified Fragment	26	2.1
Trough Metate	9	.7	Unusual Material	43	3.5
Slab Metate	2	.2	Stone Ball	8	.7
Basin Metate	2	.2	Stone Vessel Fragment	1	.1
Grooved Axe	10	.8	Stone Ring	1	.1
Maul	4	.3	Hammerstone	194	15.8
			Hafted Hammer	1	.1
			Total	1230	100.0

were not modified prior to use, provided that all those items with missing lateral margins had originally been unmodified. Between 64.1 percent and 72 percent of the items were altered to various degrees, ranging from being "sized," to being formed into a roughly desired shape, to being reduced to a fine symmetry.

Artifacts in the categories "modified" and "shaped" generally were reduced by means of large scale breakage and/or flaking, with little attention to detail. The majority of the shaped items show additional grinding of rough, broken edges, as though to smooth the roughened areas, to produce a degree of symmetry and generally to improve overall appearance. The refined artifacts may also have gone through these initial stages of alteration, but most evidence of such has been obliterated by fine pecking (small scale flaking) and grinding, which has produced relatively symmetrical articles. It is obvious that these artifacts involved more labor and were, if for this reason alone, more valuable and more likely to be curated.

Nineteen types of use wear patterns were observed on the use surfaces of the 537 utilized ground stone objects. Table 215 shows that, like the chipped stone implements, these items often have more than one use surface. A total of 828 use surfaces were observed among the 537 used implements, for an average of 1.5 surfaces per tool. Nearly half of these tools (226 items, 42.1 percent) showed at least two used areas. This is

Table 214. Modification of ground stone tools prior to use.

Condition	*Absolute Frequency*	*Relative Frequency (Percentages)*
Unmodified	120	28.0
Modified	66	15.4
Shaped	111	25.9
Refined	97	22.7
Not Present	34	7.9
Total	428	99.9

Table 215. Wear patterns on ground stone tools.

	Primary Use Wear:		Secondary Use Wear:		Tertiary Use Wear:		Quaternary Use Wear:		TOTAL	
Wear Pattern	N/	%	N/	%	N/	%	N/	%	N/	%
Striations Parellel to Long Axis	19/	3.5	11/	4.9	3/	5.6	0/	0.0	33/	4.0
Striations Perpendicular to Long Axis	116/	21.6	90/	39.8	27/	50.0	1/	9.1	234/	28.3
Striations Parellel and Perpendicular to Long Axis	4/	0.7	1/	0.4	0/	0.0	0/	0.0	5/	0.6
Striations Angular to Long Axis	6/	1.1	3/	1.3	3/	5.6	1/	9.1	13/	1.6
Multidirectional Striations	42/	7.8	23/	10.2	1/	1.8	2/	18.2	68/	8.2
Percussion on an Edge	14/	2.6	4/	1.8	2/	3.7	0/	0.0	20/	2.4
Percussion on a Surface	205/	28.2	16/	7.1	12/	22.2	6/	54.5	239/	28.9
Polish	18/	3.4	9/	4.0	0/	0.0	o/	0.o	27/	3.3
Abrasions	5/	0.9	2/	0.9	1/	1.8	0/	0.0	8/	1.0
Hole Drilled	1/	0.2	0/	0.0	0/	0.0	0/	0.0	1/	0.1
Indiscernable	2/	0.4	1/	0.4	0/	0.0	0/	0.0	3/	0.4
Multidirectional Striations and Polish	7/	1.3	3/	1.3	0/	0.0	0/	0.0	10/	1.2
Striations Parallel to Long Axis and Polish	0/	0.0	1/	0.4	0/	0.0	0/	0.0	1/	0.1
Striations Perpendicular to Long Axis and Polish	3/	0.6	2/	0.9	0/	0.0	0/	0.0	5/	0.6
Grinding, No Striations	73/	13.6	54/	24.0	3/	5.6	1/	9.1	131/	15.8
Percussion on a Surface and Grinding, No Striations	14/	2.6	5/	2.2	2/	3.7	0/	0.0	21/	2.5
Striations Perpendicular to Long Axis and Percussion on an Edge	2/	0.4	0/	0.0	0/	0.0	0/	0.0	5/	0.6
Striations Parallel to Long Axis and Percussion on a Surface	4/	0.7	1/	0.4	0/	0.0	0/	0.0	5/	0.6
Multidirectional Striations and Percussion on a Surface	2/	0.4	0/	0.0	0/	0.0	0/	0.0	2/	0.2
TOTAL	537/	100.0	226/	100.0	54/	100.0	11/	100.0	828/	100.0

a much higher proportion than was noted among the chipped stone tools. Fifty-four specimens (10.1 percent) were worked on at least three surfaces and 11 items (2.0 percent) were used on four surfaces (those items with three and four use surfaces are included in the tally of items with at least two, and those with four are included in the tally of artifacts with at least three use surfaces). These figures do not include multiple pounding surfaces on hammerstones. Each of these implements usually had numerous use areas and it often was impossible to determine how many distinct pounding surfaces were on a stone. Generally, all protuberant convex surfaces on a hammerstone were subjected to the battering or percussion indicative of hammer use. In all cases, a hammerstone was considered a single pounding surface.

Nearly all of the 19 wear patterns observed on ground stone tools resulted from variations of grinding activities (striations) or pounding activities (percussion). It became apparent during analysis that those objects with striations parallel to the long axis were always ground *upon* (as determined by their size and shape, and/or concave grinding surfaces), while those with striations perpendicular to the long axis were nearly always ground *with*, such as the manos and grinding stones. Artifacts of either category (the netherstones and the handstones) often were made of materials not conducive to, or were used in ways which did not produce, striations. In these cases, wear patterns took the form of changes in texture and color and unusually flat surfaces. Under microscopic examination, quartz crystals were seen to be sheared off even with the surrounding matrix, a feature not commonly found in the natural context.

It also was noted that those objects which were hand-held (such as manos) were far more likely to exhibit more than one use surface than were those objects which remained stationary on the ground during use (such as metates).

Distributions

Raw Materials: Spatial Distribution

Since it has been demonstrated above that the separate lithic artifact complexes (chipped stone and ground stone) are comprised of basically different raw materials, it is necessary to examine the overall distribution of raw materials in the context of each artifact complex. Otherwise, it would be impossible to determine whether the differences detected in raw material occurrence in a comparison were caused by differences in the tool assemblages involved, or if actual differences occurred in the raw materials utilized in the areas under comparison.

Table 216 illustrates the distributions for the two complexes; most notable here is the dearth of information recovered from the general site surface collection and from the Central Room Block. This pattern holds true for both complexes and presumably is due to the excavation sample.

Examination of the two raw material distributions gives fairly straightforward evidence that raw materials were evenly distributed throughout the pueblo. A chi-square test was performed on each complex, using the regrouped classes of raw material and the room blocks as units of comparison. The tests were performed on the

Table 216. Cross-tabulation of raw materials and areas of

Count *Row Pct.* *Col Pct.* *Total Pct.*	*Rhyolite*		*Chert*		*Obsidian*		*Quartzite*	
	CH	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*
General	0	0	1	0	0	0	0	0
Site	0	0	100.0	0	0	0	0	0
Surface	0	0	.3	0	0	0	0	0
Collection	0	0	.2	0	0	0	0	0
	2	0	103	13	1	0	7	22
North	1.1	0	57.5	8.9	.6	0	3.9	15.1
Room block	28.6	0	32.6	2.0	25.0	0	20.6	19.3
	.3	0	18.0	1.1	.2	0	1.2	1.8
	0	0	2	1	0	0	0	0
North	0	0	100.0	50.0	0	0	0	0
Area	0	0	.6	.2	0	0	0	0
	0	0	.3	.1	0	0	0	0
	4	1	47	8	0	0	5	17
Central	4.7	.8	54.7	6.7	0	0	5.8	14.2
Room block	57.1	33.3	14.9	1.2	0	0	14.7	15.2
	.7	.1	8.2	.7	0	0	.9	1.4
	1	1	125	23	1	0	18	54
South	.5	.4	57.6	9.3	.5	0	8.3	22.0
Room block	14.3	33.3	39.6	3.5	25.0	0	52.9	48.6
	.2	.1	21.9	1.9	.2	0	3.1	4.4
	0	1	38	606	2	0	4	21
South	0	.1	43.7	84.6	2.3	0	4.6	2.9
Area	0	33.3	12.0	93.1	50.0	0	11.8	18.8
	0	.1	6.6	49.3	.3	0	.7	1.7
COLUMN	7	3	316	651	4	0	34	114
TOTAL	1.2	.2	55.2	52.9	.7	0	5.9	9.3

total assemblage of each room block and on each occupation surface (and Level 0, and general fill). Testing for the .05 level of significance, all tests were rejected.

Projectile Points: Temporal Distribution

The form of a projectile point has often led to attributing the point to a specific date or time sequence. For instance, the Type II points (see Glossary) are typical of Southwestern points in the Basketmaker-Pueblo sequence.

The corner-notched variety (Type II–C) are considered to pre-date the side-notched points (Type II–A) in eastern Arizona (Roberts 1931: 159) and northwest New Mexico (Bice and Sundt 1972: 82). The former generally are associated with Basketmaker III to Pueblo II sequences and have been recovered from such proveniences at Pueblo Bonito in Chaco Canyon (Judd 1954: 255) and Badger House in Mesa Verde (Hayes and Lancaster 1975: 144–145). They also were recovered from undesignated proveniences at Big Juniper House in Mesa Verde (Swannack 1969: 134–135) and at Tse-ta'a in Canyon de Chelly (Steen 1966: 106–107). These points collectively (Type II–C–1 through II–C–4) comprise the most common type found at Antelope House (11 of 54 specimens, 20.4 percent).

The Type II–A points are the second most common variety (5 of 54 specimens, 9.3 percent). This variety generally is found in association with Pueblo III (and later) proveniences at many sites, including Badger House (Hayes and Lancaster 1975: 144–145) and Pueblo Bonito (Judd 1954: 254–255). At Tse-Ta'a (Steen 1966: 106–107), a single Type II–A point of unusual form (identical to a Type II–Aberrant specimen recovered from Antelope House) was recovered.

The larger varieties of points, Type III, may have originated in a number of contexts. Larger

tool collection (CH = chipped; GR = ground).

Basalt		*Granite*		*Sandstone*		*Sil. Wood*		*Chal. Carb.*		*Pigment*		*Other*		*ROW TOTAL*	
CH	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*	*CH*	*GR*
0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0	100.0	0	0	0	0	0	0	0	0	0	0	0	0		
0	4.5	0	0	0	0	0	0	0	0	0	0	0	0		
0	.1	0	0	0	0	0	0	0	0	0	0	0	0	.2	.1
1	3	1	4	1	56	59	13	0	2	2	12	2	21	179	146
.6	2.1	.6	2.7	.6	38.4	33.0	8.9	0	1.4	1.1	8.2	1.1	14.4		
25.0	13.6	100.0	33.3	20.0	26.5	31.6	14.4	0	5.7	28.6	21.4	28.6	67.7		
.2	.2	.2	.3	.2	4.6	10.3	1.1	0	.2	.3	1.0	.3	1.7	31.3	11.9
0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	2
0	0	0	0	0	50.0	0	0	0	0	0	0	0	0		
0	0	0	0	0	.5	0	0	0	0	0	0	0	0		
0	0	0	0	0	.1	0	0	0	0	0	0	0	0	.3	.2
2	4	0	4	0	46	26	15	0	8	0	13	2	3	86	119
2.3	3.4	0	3.4	0	38.7	30.2	12.6	0	6.7	0	10.9	2.3	2.5		
50.0	18.2	0	33.3	0	21.8	13.9	16.7	0	22.9	0	23.2	28.6	10.0		
.3	.3	0	.3	0	3.7	4.5	1.2	0	.7	0	1.1	3	.2	15.0	9.7
1	10	0	2	4	65	61	48	0	14	3	22	3	7	217	246
.5	4.1	0	1.4	1.8	26.4	28.1	19.5	0	5.7	1.6	8.9	1.4	2.8		
25.0	45.5	0	14.3	80.0	30.8	32.6	53.3	0	40.0	42.9	39.3	42.9	23.3		
.2	.8	0	.2	.7	5.3	10.7	3.9	0	1.1	.5	1.8	.5	.6	37.9	20.0
0	4	0	4	0	43	41	14	0	11	2	12	0	0	87	716
0	.6	0	.5	0	6.0	47.1	2.0	0	1.5	2.3	1.7	0	0		
0	18.2	0	28.6	0	20.4	21.9	15.6	0	31.4	28.6	20.3	0	0		
0	.3	0	.3	0	3.5	7.2	1.1	0	.9	.3	.9	0	0	15.2	58.2
4	22	1	14	5	211	187	90	0	35	7	59	7	31	572	1,230
.7	1.8	.2	1.2	.9	17.2	32.7	7.3	0	2.8	1.2	4.8	1.2	2.5	100.0	100.0

points commonly are associated with spears or darts and thus often predate the advent of the bow and arrow (Hayes and Lancaster 1965: 145).

The stemless Type I points, on the other hand, do not seem to be attributable to any specific period, but occur throughout the Basketmaker-Pueblo sequence.

In any case, the above sequencing does not seem to hold true for Antelope House (Table 217). Although 75 percent of all Type II–C points occur in the earlier phases (BMIII, PI, PII), so do two of the five Type II–A points. Only one Type II–A point is known to have come from PIII deposits. At the same time, six of the 11 larger Type III points come from PIII deposits rather than from earlier deposits. While some of these probably were knives, the form and patination of several specimens indicate that their manufacture predates even the earliest phases of Antelope House.

This random patterning in the distribution of points at Antelope House suggests three possibilities: (1) the morphological forms of points at Antelope House did not vary chronologically; (2) the occupants of Antelope House (particularly during PIII) scavenged points (and possibly other artifacts) from the deposits of previous phases and/or other sides; or (3) the archeological strata are considerably disturbed at Antelope House.

The fact that chronological sequences of points have been developed for so many other sites rules out the first possibility. The third possibility seems unlikely because although many of the deposits at Antelope House contained chronologically mixed remains (as shown by the category "mixed deposits" in Table 215), the remaining strata have been accurately dated and show minimal disturbance in the other artifact assemblages (ceramics, textiles, etc.). Thus, indications are that the inhabitants of Antelope House scavenged for points. This is supported by the presence of the Archaic points in later deposits.

Glossary

Because the terminology of lithic analysis has not yet been standardized, in this section I define terms used in my discussion of the stone artifacts from Antelope House.

Chipped Stone Artifacts

The raw materials used in the manufacture of chipped stone artifacts are silicious in nature, such as chert, chalcedony and quartzite. These materials have a cryptocrystalline structure with a high silica content and physical properties similar to those of water (Chapman 1973). As stone is a denser medium than water, the oscillations traveling through the body of such material when struck create a fracture detaching a piece of debitage or flake from the body of the parent material.

All objects manufactured in this manner exhibit a set of attributes common to all chipped stone artifacts (thus enabling their identification as such), as well as additional attributes directly related to their intended function (such as shape, retouch patterns and wear patterns). These items have been discussed at great length by Chapman (1973), Crabtree (1972), and Wilmsen (1970).

Table 217. Recovery of projectile points, by type.

	Type I-A-2	*Type I-B*	*Type I-C*	*Type I-D*	*Type II-A*	*II-C*				*Type II-D*	*II-Aberrant*	*Type III-A*	*Type III-B*	*Type III-C*	*Type III-D*	*Type III-E*	*Type III-FRPG*	*Fragments*	*Other Forms*	*Preforms*	*TOTAL*
						II-C-1	*II-C-2*	*II-C-3*	*II-C-4*												
Basketmaker III						1															1
Pueblo I		1			1	1		2								1			1		7
Pueblo II		1			1	1	1										2	1			7
Early Pueblo III																		1	2	2	5
Middle Pueblo III								1		1		1								1	4
Late Pueblo III	2				1	1						1		1			3	4			13
Navajo											1										1
Mixed Deposits			1	1	2				3		1		1		1				4	2	16
Total	2	2	1	1	5	4	1	3	3	1	2	2	1	1	1	1	5	7	6	5	54

Artifact Type.

Analysis of the chipped stone items from Antelope House produced a classification consisting of 56 varieties of artifacts, based on clusters of the above attributes. For the purposes of this report, each of the types was assigned a tentative identification label.

Primary Core

A primary core is a piece of parent material which exhibits one or more debitage scars, indicating that flakes were deliberately removed (Chapman 1973: 309–310). A core is thus a portable source of usable raw material. Schaafsma (1977: 182) defines primary cores as "original pieces of parent material that have been worked down." For the purposes of this report, it is further stipulated that the primary core exhibits sufficient bulk and striking platforms to be used further.

Secondary Core

Also called flake cores, secondary cores are large flakes from which smaller flakes have been removed (Schaafsma 1977: 183). Besides displaying a large positive bulb of percussion and one or more smaller negative flake scars, there must be evidence that the smaller flakes were removed after the item was removed from the primary core or parent material. Otherwise, the object may represent simply a large flake removed from a core after other smaller flakes have been removed, leaving their negative scars on its dorsal surface. Such evidence can be found in platform preparation or flake removal affecting the ventral surface of the secondary core.

Core Nucleus (Expended)

A core reduced to such a size and/or shape that further flake detachment is not possible is referred to as a core nucleus.

Hammerstone

This refers to items showing deliberate platform preparation and flake removal, as well as additional pounding and battering on the convex surfaces common to hammerstones.

Core/Scraper

These are multiple use tools, both serving as a source of flakes and exhibiting (usually in conjunction with flake removal) edges of proper dimension and angle to function in a variety of scraping activities. If the edge were used, the implement had multiple use, at least for a limited time.

Core/Chopper

Artifacts in this class show deliberate flake removal and at least one edge exhibits massive percussion and crushing.

Chopper

This item usually exhibits one utilized edge with bifacial retouch and massive percussion on the apex of the edge. This wear is produced by pounding the edge of a hard, resistant surface, such as in chopping bones or wood (as opposed to cutting with a sawing motion).

Core/Knife

An item that was a source of usable debitage and that also shows cutting wear (bifacial attrition) is called a core/knife.

Unutilized Flake

The majority of debitage, including nearly all shatter, shows no alteration through retouch or use. Some of these show thin edges usable for a number of purposes, but which were not used. Others simply could not have been used because of their morphology. All have been lumped into this category, including those implements exhibiting edge damage for which it was impossible to determine the cause of the minute patterns on the edges.

Scrapers

Items showing step fracture and/or unifacial chipping are considered to have been used in scraping activities (Chapman 1973; Schaafsma 1977: 190–192). Honea (1965: 36–39) suggests a number of types of scrapers, some of which are employed in this report. All are based on the location and the number of the edges on the item, as well as the morphology of the flake. It should be noted that a used portion of an edge does not necessarily take up the entire edge; in fact, one edge may exhibit two separate utilized portions.

Scraper—Shows wear on the distal end of the flake.

Side-end Scraper—Shows at least two edges, one on the distal end of the flake and one on the

lateral side. These use edges may intersect at a corner.

Single Side Scraper—Exhibits a single scraping edge along one lateral side of the tool. If there were more than one working edge, all would occur on the same lateral side.

Double Side Scraper—Exhibits at least two scraper edges, each on a lateral side.

Convergent Side Scraper—At least two scraper edges are found, each on a lateral side. This tool differs from the double side scraper in that the two edges come together at one end of the implement.

Transverse Scraper—This type of end scraper is wider than it is long.

Indeterminate Scraper Fragment—A number of scraper edges were discovered on fragmentary items, the original shape and morphological location of which were impossible to determine. These items are classified as indeterminate scraper fragments.

Plane

A different kind of scraper wear was noted on some implements. These show bifacial step fracture, much heavier on one face than on the other. Striations also are noted perpendicular to the use edge. It is suggested that these items were used for planing, in which the use edge is applied to the working surface at an acute angle and pushed away from the user.

Knife/Scraper

The single most common combination or multi-use tool found exhibits scraper wear (unifacial step fracture and chipping) and cutting wear (bifacial attrition). These tools often have more than two use edges.

Knife/Gouge

Items showing a cutting edge, as well as a projection with unifacial step fracture along the apex of the protuberance (and parallel to the long axis of the protuberance), is indicative of another kind of multiple use wear: cutting and gouging. Gouge wear may have been produced by chiseling or planing, but most likely by the former method, due to the size of the projections.

Knife

Any item exhibiting bifacial attrition, either light or heavy, along one or more thin edges is classified as a knife. This is the most common form of wear found on items in this study. Many of the knives are in the form of utilized flakes (as are the scrapers), although some also exhibit retouch along the utilized edges. Specimens with a combination of retouched and unretouched edges are common.

Knife/Spokeshave

These tools show attrition on at least one edge, and a concave edge with unifacial step fracture (occasionally bifacial) on another portion.

Gouge

These are tools which exhibit at least one projection from a margin; the projection shows unifacial step fracture along the distal end, the step fracture running parallel to the long axis of the projection. The wear can be caused by planing action or by chiseling action, but the small size of the projections indicates they were used in the latter manner.

Graver

Gravers resemble miniature drills. Their projections are quite small and rarely are produced through retouch. These projections exhibit rotary wear along the shafts and on the tips, usually as striations. The tips of the projections may be polished or crushed, depending on the intensity of use and the material worked with the tool. Although the name implies that they were used for engraving, it is just as likely that they were used as light duty drills on thin, relatively soft materials.

Drills

Two types of drills were analyzed. They have been classified along the lines set up by Linford (n.d. b). Therefore, there are gaps in the numbering system where expected types were not found.

Drill Type III—This type of drill is characterized by a broad, triangular body with a projection at one end exhibiting rotary step fracture, rotary chipping and rotary striations.

Drill Type IV—This drill shows very little alteration, except for the projection or shaft. The base retains the original, amorphous shape of the flake from which the drill was produced.

Drill, Indeterminate Fragment—Those bits of drill shafts, the original shape or length of which is impossible to determine, were placed in this category.

Drill/Knife Scraper

This category refers to implements with at least one edge exhibiting bifacial attrition, as well as a projection showing heavy rotary step fracture, rotary chipping and/or rotary striations.

Projectile Points

A wide variety of projectile points was recovered from Antelope House. These have been classified according to size, blade shape, presence or absence of stem and shape of base.

Type I—The stemless varieties.

Type I–A—Triangular, breadth of base nearly equals length. Type I–A–1—Excurvate sides, incurvate base. Type I–A–2—Straight sides, straight base.

Type I–B—Lanceolate, excurvate sides, concave base.

Type I–C—Lanceolate, straight sides, expanding base.

TypeI–D—Lanceolate, straight sides, superficial side notches.

Type II—The stemmed varieties.

Type II–A—Triangular, side notches at 90° to long axis, stem as wide as shoulder and comprising approximately one-third the length of the point, base flat or concave.

Type II–B—Leaf-shaped, broad-triangular notches, expanding stem narrower than shoulder and comprising less than one-third the length of the point, base flat.

Type II–C—Triangular, side notches angle up toward tip. Type II–C–1—Broad triangular, expanding stem comprising approximately one-third the length of the point, base flat. Type II–C–2—Narrow triangular, stem blunt and rounded, comprising less than one-third the length of the point. Type II–C–3—Narrow triangular, stem elongated (peg-like) comprising approximately one-third the length of the point. Type II–C–4—Narrow triangular, stem expanding, comprising less than one-third the length of the point.

Type II–D—Triangular straight or rounded shoulders, straight nonexpanding stem narrower than shoulders, comprising approximately one-third the length of the point.

Type II-Aberrant—Stemmed points which do not fit any of the above descriptions.

Type III—Large points.

Type III–A—Triangular, side notches at 90° angle to long axis, stem as wide or wider than shoulder and comprising approximately one-third the length of the point, base flat or concave.

Type III–B—Triangular, breadth of shoulders nearly equal to the length of point, side notches angle toward tip, base concave.

Type III–C—Triangular, wide triangular notches and concave base forming an "ear-like" base.

Type III–D—Triangular, notches angle toward tip of point, short peg-like stem less than one-third the length of the flake.

Type III–E—Triangular, straight or rounder shoulders, straight nonexpanding stem narrower than the shoulders comprising approximately one-half the length of the point.

Type III Fragment—Fragments of larger points.

Point Fragments—Fragments which are not attributable to any particular type or subtype.

Point, Other Varieties—Points which do not fit any of the above classifications.

Point Preforms —Incomplete points, usually lacking secondary retouch, notching, etc.

Bifacial Knife

A large, realtively flat object made of chert, this sort of item shows facial retouch, as well as secondary marginal retouch, on a much larger scale than do the knives and scrapers. Both ends tapered to a wedge-like point in cross section and are slightly rounded in outline. The item may have been hafted.

Flaked Axe

A large, relatively flat object made of chert, this sort of item shows facial retouch, as well as secondary marginal retouch, on a much larger scale than do the knives and scrapers. Both ends tapered to a wedge-like point in cross section and are slightly rounded in outline. The item may have been hafted.

Unknown

Those items which were impossible to identify were placed into this class. Some show at least minimal retouch and most are bifaces, but with little or no wear.

Unusual Material

Several pieces of raw material were recovered which exhibit no modification or use wear, but which are not common to Canyon de Chelly. Their presence suggests that they were transported to the site for some purpose that was not fulfilled. The materials include two specimens of silicified wood, one of clay, one of limonite and one of an unspecified material.

Indeterminate Preform

A number of large, bifacially retouched implements were recovered which, like the projectile point preforms, lacked secondary retouch and use wear. These were most likely unfinished artifacts, still in the preform stage.

Striking Platforms

Prepared—This category includes all specimens showing no cortex on the striking platform.

Post-Detachment Removal—Those artifacts modified to the point of obliterating all traces of the striking platform. This includes all bifaces and most unifaces.

Not Present—The largest portion of items recovered from Antelpe House exhibited no platform; the platform either was broken off or perhaps the item never had one.

No Alteration—A number of the flakes showed no alteration of the stone before or after the flake was detached.

Refined—This category refers to those items exhibiting modfication of the striking platform which surpasses simple cortex removal. Some show fine flaking or crushing, while others exhibit light grinding on the striking platform.

Stage of Manufacture—Fifteen stages of manufacture were recognized in this analysis. These criteria are based in large part on those described by Chapman (1973) and Schaafsma (1977).

Utilized Parent Material—This refers to an object taken in its natural form and utilized without modification. An example of this would be fragments of quartzite with relatively sharp edges and which show signs of having been used. The object was not produced by man, but was utilized.

Cores—Includes primary, secondary and core nucelus. All are the same as described under artifact types above.

Debitage—Any piece of material removed from a core through the application of force is debitage (Chapman 1973: 5). Within this category are several varieties of specimens based on the presence or absence of cortex on the distal surface and the mechanical processes used to remove the flake from the core. The two main divisions are flakes and shatter (see below). A flake will exhibit a striking platform on the proximal end, a bulb of force on the ventral surface and may have cortex on the ventral surface. The condition of the cortex on the dorsal surface is noted by the terms primary, secondary, and tertiary applied to the flake type. A primary flake has cortex over the entire dorsal surface, a secondary flake has cortex over any part of the dorsal surface, and a tertiary flake lacks cortex. Shatter includes irregular, blocky pieces or splinters or material which lacks most of the characteristics of flakes. These items probably were not deliberately removed from the core, but are a by-product of the removal of other flakes arising from faults in the raw material or from application of excessive force. They usually lack a thin edge or an edge capable of being utilized (Linford n.d. b).

Soft Hammer Flake—This first flake type refers to those apparently detached from the core using a hammer or percussion device of softer material, which, when contracting the core, gives in plastic deformation, diffusing the force through a wider area of contact with the striking platform. According to Crabtree (1972: 44), this results in a small lip, or overhang, where the platform meets the ventral surface immediately above the bulb of percussion. In addition, the bulb of force is more diffuse. Soft hammer flakes generally are thinner than are the hard hammer flakes and show more pronounced rippling or shock waves on the ventral surface. This is in part supported by Frison (1968: 149), who states that "soft hammer technique is indicated by a broad, thin flake, with a definite overhang on the bulbar face." However, more recent work by Hammond *et al.* (1975) indicates that there are no significant differences between hard hammer and soft hammer flakes in terms of weight.

Hard Hammer Flake—These flakes were detached from the parent material with a firmer, less plastic hammering implement. The force is concentrated in a very small area, remaining concentrated rather than diffusing as with soft hammering. The result is that the bulb of percussion is much more pronounced (Crabtree 1972: 44).

There is no lipping on the bulbar surface and, according to some experimenters, the flakes generally are thicker than the hammer flakes (Frison 1968: 149).

Thinning Flake—These flakes generally are removed from the parent material by pressure (or light percussion) to thin the piece for artifact manufacture. They usually show special platform preparation (Crabtree 1972: 94). These flakes generally are associated with the production of unifaces and bifaces. They are thin and flat, with a diminutive bulb of percussion, and are, in general, smaller than the other flake types.

Resharpening Flake—These items are flakes which have been removed from the retouched edges of unifaces and bifaces in order to sharpen dulled edges. They are characteristically thick, short flakes with no striking platform and heavily worn retouched edges on the distal end.

Unifaces (complete and partial)—An artifact which exhibits thinning flake scars on one surface, is considered to be a uniface. (This does not include those implements showing unifacial marginal retouch in the absence of facial or thinning modification.) They can be prepared from various flake types, although the original stage of manufacture has often been obliterated and is impossible to determine (Schaafsma 1977: 184). The terms "complete" and "partial" in this case refer to the extent of the facial retouch. Those artifacts having such retouch over the entirety of both surfaces are considered to be complete (such as many scraper types), while those exhibiting any portion of the original (unretouched) surface on either/or both faces are considered partial unifaces.

Bifaces (complete and partial)—Bifaces are identified by the same criteria as are the unifaces, except that the retouch (thinning) is seen on both surfaces.

Other—This category was created in order to classify those implements not fitting into any of the above categories. Generally they are few in number, each usually being unique and constituting a new stage of manufacture.

Unidentifiable—These items usually are unidentifiable because fragmented.

Fragmentation

As most of the artifacts recovered from an archeological site are those no longer needed by the owners (Jelinek 1976: 21), a large percentage of them can be expected to be recovered in fragmentary form, having been broken by the original owner. Further breakage can be caused by natural processes. There is a need to distinguish between those artifacts which were complete when deposited (and thus presumably still usable) and those which were not.

In trying to determine the condition of the artifact at the time it was deposited, the type of fracture is considered in addition to the state of fragmentation. The observed types of fracture are noted below.

Manufacture Break—This refers to the typical "rolling fracture" produced by too much force in biface manufacture. When present, it usually is easily recognizable.

Use Break—Several types of fractures are considered to have occurred through use, such as impact fractures and snap.

Unknown—This class was used when the cause of the break was not discernible.

Recent—Several specimens examined obviously had been broken after removal from the archeological context.

Production Break—Often when a flake is being produced or removed from the core, it is broken into two or more pieces by the impact. These flakes usually terminate in a hinge or exhibit a negative hinge fracture at the proximal end.

Marginal Retouch

As opposed to the facial or surficial retouch used in discerning stage of manufacture, this criterion refers to the deliberate alteration of a margin or edge. Such retouch parallels the edge, forming a uniform border. This retouch generally is more than 3 mm to 4 mm wide, but varies extensively with the size of the artifact.

Use Wear

This criterion distinguishes alteration of the edge through use from deliberate alteration through retouch. The former usually forms smaller flake scars than the latter, and these usually are more regular both in size and distribution. A number of varieties of use wear are created by the different motor habits of various users. Twenty patterns of use wear were recognized in analysis of the Antelope House materials.

In developing these criteria of description, works by Tringham *et al.* (1974) and Chapman (1973) were consulted. The terms "unifacial" and

"bifacial" are used here, replacing Chapman's "unidirectional" and "bidirectional." These terms refer to the use wear being predominantly on one or both faces of an edge (formed by two faces coming together).

None—This is not to be confused with those items upon which wear is expected but not seen (indiscernable) or damage to the edge which may or may not be caused by use (edge damage).

Unifacial Step Fracture—Step fracture nearly always occurs in unifacial patterns and is created by a vector of force being applied perpendicular to the longitudinal axis of the edge being examined. Minute flakes hinge-fracture as they are detached from the surface of the edge opposite the vector of force (Chapman 1973). Most researchers agree that this type of wear is caused by scraping. Light step fracture is indicative of working of soft materials, while heavy step fracture is indicative of working on hard materials with the tool (Tringham *et al.* 1974: 191).

Unifacial Chipping—Scraping activities also produce a type of flaking which results in scalar-shaped scars (Tringham *et al.* 1974: 188), which lack hinges at the distal end but which also occur primarily on one surface of the edge. It has been suggested that these scars are indicative of work with much softer materials, such as hides and skins (Tringham *et al.* 1975: 189).

Bifacial Attrition—Attrition consists of scalar scars (Tringham *et al.* 1974) or feathering scars (Chapman 1973) on both faces of the edge. The scars may or may not show step fractures or hinges at the distal ends. Tringham *et al.* (1974: 187) suggest that this type of wear results from moving the edge longitudinally, holding the cutting edge parallel to the direction of motion. Chapman (1973) refers to this as sawing motion. According to Tringham, the lighter attrition scars generally lack hinges and indicate cutting of soft materials, such as skins and hides. The heavy attrition scars are larger and are indicative of cutting harder material, such as wood or bone (1974: 189–191).

Bifacial Percussion (on the edge)—According to Schaafsma (1977: 193), this is indicative of chopper wear and consists of massive attrition-like scars exhibiting splintering and crushing along the proximal ends (on the apex of the use edge), accompanied by other types of wear, such as large step fractures. These are the result of direct blows on some unyielding surface, such as might occur in chopping wood or bone.

Percussion on an Original Surface—According to Schaafsma (1977: 194), this wear is recognized by crushed and splintered areas similar to those seen on the edges of choppers, but is found on the surface of the face of an object (such as a hammerstone).

Light Rotary Chipping and Rotary Step Fracture—Items with projections protruding from the main body often show a pattern of chipping or step fracture on the edges of the projection. The wear is unidirectional; it goes the same direction on all edges and is perpendicular to the longitudinal axis of the edges. Chapman (1973) and Schaafsma (1977: 194) suggest that this wear is produced by turning the item in the manner of a drill. It is assumed that certain materials would produce the chipping and that others would produce the step fracture, but this has not been tested.

Polish—Polish generally is difficult to identify under the minimal magnifications used in this analysis. For this reason, I followed Schaafsma's example (1977: 194) and recorded polish only when clearly visible and the only type of wear found.

Edge Damage—Many items in the chipped stone assemblage show limited and dispersed damage on a thin edge, which is not immediately recognizable as the result of any speific use. Although Tringham *et al.* (1974: 181–183) suggest the possibility of distinguishing between those patterns left by natural forces (water, sand) and those created by use, a number of instances will occur in any assemblage which are borderline. For this report, borderline "wear" is termed edge damage and may or may not indicate use wear.

Indiscernible—Contained in this class are most bifacially retouched implements upon which wear patterns were expected but are indistinguishable from the crushing and striations created in the preparation of each striking platform for each retouch flake (Sheets 1973: 215–218; Hester and Heizer 1973: 220–221).

Crushing—This wear refers to the massive fracturing and flaking noted in the description of percussion. However, it sometimes was discovered on edges too thin or on artifacts too small to be used for chopping. In these cases, it commonly was interpreted as "backing" or in-

tentional dulling, such as occurs on the basal edges of projectile points to prevent the point from cutting its own binding.

Edge Angle—Wilmsen (1970) notes that the angle of an edge may vary in relation to the use of an artifact, different uses requiring different angles for optimal performance.

The angle measured here is that measured by Tringham *et al.* (1974: Fig. 1) and reflects the cross section of the flake. The spine angle of the edge or the apex angle was measured on unretouched edges. This gives a better picture of the original angle before use wore it down, for this was the angle sought by the user of the implement. On those edges showing retouch, the new angle created by the deliberate alterations was measured, taking care to avoid the alterations caused by wear.

Ground Stone Artifacts

Ground stone artifacts are made of larger-grained, non-silicious raw materials, such as sandstone and basalt. These materials lack concoidal fracture properties and are formed into desired shapes by means of abrasion and/or pecking (the removal of amorphous chips and pieces by percussion). These artifacts generally are associated with the processing of vegetal foods.

There is more variety in the ground stone complex than in the chipped stone complex and more of the forms are deliberately shaped. However, there seems to be more uniformity among the ground stone complexes of different sites than among the chipped stone complexes. Thus, many of the items recovered from Antelope House are typical of types found in nearby sites.

Grinding Stones

Implements which were hand-held and used for light grinding without benefit of previous modification (with the possible exception of sizing) are called grinding stones. They usually are not symmetrical and even the grinding surfaces show no preparation.

Manos

Manos are hand-held grinding implements which differ from grinding stones in that they generally are larger and heavier. Furthermore, manos exhibit more extensive modification (often being refined to a particular symmetrical shape) and nearly always show more intensive and extensive use wear (in the form of unidirectional striations running perpendicular to the long axis of the tool).

One-Hand Manos—A series of smaller, lighter manos commonly are referred to as "one-hand manos" (Hayes and Lancaster 1975: 154–155) or "hand stones" (Rohn 1971: 241; Swannack 1969: 122). These are either oval or subrectangular in outline and have two grinding surfaces (one on each face), which are slightly convex in cross section.

Two-Hand Manos—The second major type of mano identified at Antelope House is the longer "two-handed" variety. Within this type are 13 subclasses based primarily on the cross section of the mano. Manufacture, use and maintenance all affect the shape of the mano by forming and/or enhancing facets or grinding surfaces. Increasing the use and maintenance increases the number and extensity of the facets, which in turn affects the cross section of the mano.

Type I Manos—One grinding surface, usually plano in cross section. The opposite surface is unused, therefore irregular.

Type II Manos—Two grinding surfaces, one on either face of the artifact. II–A—Two plano, parallel grinding surfaces. II–B—Two plano, non-parallel grinding surfaces. II–C: Two parallel grinding surfaces, one plano, one convex. II–D—Two convex, parallel grinding surfaces. II–E—Two parallel grinding surfaces, one plano and one concave.

Type III Manos—Three grinding surfaces, two of which occur on separate facets of one face. III–A—Three grinding surfaces, forming a truncated wedge-shaped cross section. III–B—Three grinding surfaces forming a triangular cross section.

Mano Preforms—Two specimens were recovered which had the rectangular outline of manos and exhibited two roughly flat, parallel faces. Judging by the roughness of the worked portions, these tools were in the initial stages of manufacture and thus have been categorized as "preforms."

Mano Fragments—Fragments which could not be placed with any certainty into any of the above categories.

The vast majority of the two-hand manos are subrectangular in outline and the grinding surfaces, regardless of the cross section shape,

are nearly always convex in long section, making the manos narrower at the ends than the middle.

This sort of wear has been described as typical of manos used in trough metates and has been noted at Badger House (Hayes and Lancaster 1975: 152–153), Mug House (Rohn 1971: 204–205), Big Juniper House (Swannack 1969: 115) and Mesa Verde and Pueblo Bonito in Chaco Canyon (Judd 1954: 138).

The assemblage from Tse-ta'a in Canyon de Chelly, on the other hand, includes only manos with a single grinding surface. One of these has "red ochre" on the grinding surface.

Multiple Use Manos—In addition to the major classes of one-hand and two-hand manos, eight specimens were analyzed which exhibit typical mano use wear patterns on one face and a second type of use wear on the opposite face.

Ground Slabs—While the grinding stones and manos are the "active" stones in a grinding system, a wide variety of "passive" or "nether" stones are used to grind upon. These stones generally are large and heavy and remain immobile during use. Ground slabs exhibit little or no modification (with the possible exception of sizing) and show light to moderate grinding wear, generally in the form of striations parallel to the long axis.

Anvils—These objects resemble the ground slabs, but they generally are thicker and heavier and always show percussion on the use surface in addition to striations. The percussion generally is concentrated in one or more limited areas and apparently is not due to surface preparation or maintenance, but to pounding something on the stone.

Pallets—Pallets generally are smaller than ground slabs and exhibit intensive, concentrated wear, yielding a concave, very fine to polished grinding surface. These objects are unifacial (with the exception of one mano-pallet) and show light to heavy encrustations of red pigment or "red ochre." The typical wear consists of light striations parallel to the long axis.

Mortars and Pestles—Mortars are squarish, blocky pieces of stone with a deep, cylindrical depression with a rounded bottom in one surface. Pestles are cylindrical stones with one rounded end exhibiting percussion and rotary multidirectional striations. (None of the mortars or pestles from Antelope House were found in association with one another.)

Griddles

Three flat sandstone slabs, here called griddles, exhibit heavy fire or smoke-blackening overall. The surfaces are flat and smooth, but do not appear worked.

Metates

Metates comprise the second largest complex of "passive" ground stone implements. Metates are similar to the "active" manos in that they exhibit considerable modification prior to use. Not only are the lower (underneath) surfaces often shaped to improve stability while in use, but the lateral margins are extensively modified to produce symmetrical forms. The use surfaces show no irregularities, such as bumps or pits, and are usually of a uniform texture from end to end and from side to side. The grinding surfaces frequently exhibit modification and/or maintenance in the form of uniform pecking or percussion applied to roughen or "resharpen" the surface. Use wear is heavier than on the ground slabs and consists of heavy striations parallel to the long axis.

Flat Metates—These metates appear to have been fashioned from large boulders, with one face worked down to a broad flat surface extending side to side and from end to end. This surface may be slightly concave in long section. The lower surface will show little or no modification. Swannack (1969: 114–115) refers to this type as plain-faced and dates such metates generally to Late PII or Early PIII. He notes that they had replaced the trough metates at Big Juniper House (Mesa Verde) by Middle PIII (around AD 1200). They also were noted at Mug House (Rohn 1971: 202–203).

Trough Metates—The grinding surface of such a metate has been pecked and ground into the face of the stone, forming a trough or trench which may be open at both ends or closed at one end. None of the nine specimens from Antelope House is complete, making it impossible to determine whether they are open or closed troughs. The trough metate was common in Late PII and well into PIII at Badger House (Hayes and Lancaster 1975: 151), Big Juniper House (Swannack 1969: 115), and Pueblo Bonito (Judd 1954: 132–137). It was the only variety found at Tse-ta'a in Canyon de Chelly (Steen 1966: 101).

Slab Metates—The two faces are both quite flat and the lateral margins have been bifacially flaked, or "spalled," and lightly ground to form

a rounded rectangular outline. Slab metates were recovered at Big Juniper House in Mesa Verde, where they are contemporary with flat metates (Swannack 1969: 115). They also were found in large numbers at Mug House (Rohn 1971: 201–203) and Badger House (Hayes and Lancaster 1975: 151–152) in Mesa Verde.

Basin Metates—These artifacts consist of a large, relatively flat-topped, tabular stone with a somewhat ovoid, conical depression near the center. These metates were used with one-hand manos and are considered to predate the other varieties described above.

Axes

The 22 specimens from Antelope House are grouped into two gross categories on the basis of modification for hafting. All are single-bitted.

Grooved Axes—This variety of axe exhibits a groove pecked and ground completely around the girth of the axe, approximately one-half to two-thirds the length of the blade from the cutting edge. This groove is most pronounced at the top and bottom of the axe, but is visible on either face. These axes usually are more refined than the notched axes, being more symmetrical in shape, and usually exhibit extensive polish in forming the bit. The butt ends are flat to bulbous and show extensive battering. Lateral margins exhibit considerable refinement.

Notched Axes—These axes are less formal than the ground axes, showing only minimal modification. Notched axes generally are made from thinner, more tabular pieces of stone. Hafting is aided by forming two broad notches (fashioned through bifacial flaking) at the top and bottom of the axe. Bits usually show little or no polish, but are formed through rough flaking; the lateral margins show no refinement. The butt ends are flat to bulbous and show extensive battering.

Both grooved and hafted axes were abundant at Tse-ta'a (Steen 1966: 102–103). Both were found at Mug House, Big Juniper House and Badger House, but the grooved variety predominated at those sites (Rohn 1971: 212–231; Swannack 1969: 130–131; Hayes and Lancaster 1975: 148–149). Both axes also were found at Pueblo Bonito (Judd 1954: 239–240).

Eight of the Antelope House axes (35 percent) are made of hematite, a pattern also noted in Canyon de Chelly at Tse-ta'a (Steen 1966: 102–103). At both sites the hematite axes are somewhat smaller than the others, but show extensive wear.

In addition to the two main varieties, four fragments were recovered which could not be placed in either category with any certainty. Two other specimens are of the grooved type, but they had been used secondarily as grinding stones. One specimen was recovered that is so small it could not have functioned as a true axe and has been tentatively classified as a toy.

Mauls

Mauls are somewhat bulbous in shape and slightly flattened on the two faces. Those from Antelope House have a full groove around the girth of the artifact at the approximate midline. Both ends exhibit extensive battering and percussion. One of these tools showed secondary use in the form of grinding wear on one face.

Abraders and Polishers

These objects appear to have been used for light, even grinding or polishing on hard, firm objects, such as stone, bone, or wood. For some, the function is known from previous literature; for others, function may be postulated or may be unknown.

Abraders—Six small (apparently hand-held) implements of sandstone exhibit at least one heavily used surface ground to concavity. Wear is heaviest at the center and consists of multidirectional striations or of grinding with no striations. Judd (1954: 118–124) describes abraders from Pueblo Bonito, but the specimens from Antelope House more closely resemble those described by Rohn from Mug House in Mesa Verde (1971: 206–207), which he called "grinding stones," and those found at Big Juniper House (Swannack 1969: 123–124), called "tabular flat abraders."

Shaft Smoothers and Polishers—Four tabular implements exhibit rounded grooves ground into one face. The grooves are semicircular in cross section (about 1 cm wide), straight in plan view and of equal depth from end to end (open at both ends). The creation of these grooved implements traditionally has been ascribed to the act of rubbing a long round object forwards and backwards on the face of the tool, eventually wearing a groove (Judd 1954: 119).

The specimens from Antelope House fall into two categories: those made of sandstone, which are abrasive, and those made of calcium

carbonate, which are polished. It is assumed that the first variety would have been used for smoothing an arrowshaft and the second to refine the surface, perhaps creating a fine sheen.

Artifacts similar to the first variety (the smoothers) were noted at Pueblo Bonito (Judd 1954: 119) and at Mesa Verde at Mug House (Rohn 1971: 229), Badger House (Hayes and Lancaster 1975: 158), and Big Juniper House (Swannack 1969: 125). None were noted at Tse-ta'a.

Polishing Stones—Seventeen small pebbles of quartzite and chert exhibit at least one polished facet. The facets are slightly convex to flat and the polish usually is accompanied by light, multidirectional striations. Some are lightly stained with red or gray. These items traditionally are considered pot polishing stones (Judd 1954: 125) and were identified at Badger House (Hayes and Lancaster 1975: 157) and Big Juniper House (Swannack 1969: 126) at Mesa Verde, as well as at Pueblo Bonito.

Polished Stones—Thirty-three pieces of highly polished tabular stone were recovered for which the function remains unknown. All but three are calcium carbonate. Each stone has two flat faces and is rectilinear in shape. Judging from the few complete specimens, they originally were about 12 cm long, 3 cm wide and 1.5 to 2 cm thick. The lateral margins have been shaped, often refined. One face exhibits extensive polish and multidirectional striations. The opposite face is flatter and shows minimal, light abrasion.

Three of these tools seem to be in the preform stage, as the lateral margins have been refined, but polish is absent from the surface.

It is not known whether the polish is deliberate modification or due to specialized use wear. Only at Tse-ta'a in Canyon de Chelly (Steen 1965: 104–105) have similar items been found. Steen suggests a similarity between these stones and modern lapidary stones, but the only evidence of lapidary work at Antelope House consists of a bead necklace and a bead bracelet from a single burial.

Hoe/Grinding Stone

A single tool was analyzed which seems to have been agricultural in nature. It is an elongated, tabular piece of sandstone that comes to a rounded point at one end. This end shows limited modification in the form of bifacial flaking. Use wear consists of percussion and massive bifacial abrasion, with striations radiating away from the tip. This type of wear would result from striking the tool into the soil. Approximately two-thirds of the way toward the butt end, each lateral side exhibits a single rough notch (bifacially flaked) to facilitate hafting. This tool also exhibits grinding wear on one face.

Problematical Artifacts

A number of unusual artifacts were recovered which bear no resemblance to any of the defined artifact types. Twenty-two of these are fragmentary and have been classified as unknown. Four others are simply highly polished pebbles of striking color. Some of the others include:

Tapering Stone Cylinder—This object of sandstone is 6.4 cm long and 1.4 cm wide. One end tapers to a truncated cone, while the other end is bifacially ground to form two flat facets. Both ends are ground flat. Function is unknown, but this item is remarkably similar (in miniature) to a *tiponi*, or corn goddess, found at Big Juniper House, Mesa Verde (Swannack 1969: 139–140).

Gaming Stone (die)—A single gaming stone, a white polished cylindrical pebble, was found. It showed no modification other than extensive handling.

Stone Ring—A fragment of a large stone was recovered. The arc of the fragment indicates a ring of material about 20 cm in diameter. The ring itself is 4 cm high and 2.5 cm thick. Function is unknown.

Stone Vessel—Another unusual fragment appears to have been part of a small, quartzitic stone bowl. The outside and inside surfaces have been refined and are vertical. Although the fragment is too small to aid in determining the overall configuration, it is too large to have been a pipe bowl and too fine to have been a mortar. Function is unknown.

Disks and Potlids—Seventeen discoidal pieces of various types of stone were recovered. Four of these are complete enough and of sufficient size to place them in the category of pot covers (see Rohn 1971: 198–199; Hayes and Lancaster 1975: 160; Swannack 1969: 142; Judd 1954: 127–128). These disks show no use wear and only minimal modification (shaping of the lateral margins). The remaining specimens are fragmentary and most are too small and/or too finely made to have served as pot covers. They may be

spindle whorls, but no perforations were noted. Some of these specimens are modified in size and shape and some show light polish.

Tabular Knife—Three fragments of sandstone slabs have edges bifacially ground to an acute angle along one lateral margin. Judd identified similar specimens at Pueblo Bonito as sandstone saws (1954: 124–129). They also were found at Big Juniper House (Swannack 1969: 124).

Stone Balls—Five of these are hematite spheres approximately 6 to 10 cm in diameter and quite heavy. They are quite smooth and exhibit a light patination, possibly caused by extensive handling. The remaining three are sandstone spheres approximately 2 to 3 cm in diameter. They appear to have been deliberately fashioned but show no use wear. Similar balls were found at Badger House (Hayes and Lancaster 1975: 162) and Big Juniper House (Swannack 1969: 144). Their function is unknown, but they may have served as gaming stones.

Unidentifiable Fragments—Twenty-six items were found which exhibit one or more ground surfaces, but which are too fragmentary to be placed with any certainty in any established category. Most probably are fragments of manos, metates, grinding stones, or ground slabs.

Chapter 28

Social Organization

> Along with this advance (change from circular to rectangular rooms), or perhaps preceding it, the social organization of the tribe, or its division into clans and phratries, would manifest itself and those who 'belong together' would build together. (Mindeleff 1897: 194)

This chapter relates the evidence and discussions presented in previous chapters to the social organization of the Antelope House population. Our data are derived from the clusterings of artifact attributes from Late Pueblo III, the period for which we have the most complete data. The strategy employed here has a tradition which can be traced at least through the writings of T. Mitchell Prudden (1903) who observed a characteristic architectural module (room block plus kiva) and inferred the presence of a "clan;" the kiva served a ceremonial function and the rooms provided space for work and storage. Numerous authors have elaborated the idea (Haury 1934; Rohn 1972; Watson Smith 1971). Longacre (1971) and Hill (1971) extended the technique by predicting the patterned occurrence of ceramic designs in terms of architectural room block units from a general model of descent and postmarital residence. Deetz (1968) expressed the principles underlying this approach, which relies upon detecting stylistic, rather than functional, clusters of artifacts and/or attributes and the sex responsible for production and use of the artifact.

We, however, have not attempted to infer the recruitment rules or postmarital rules of hypothesized units. Through the delineation of activity groups involved in the production of architecture, ceramics, textiles, sandals, and basketry we have attempted to determine whether these groups constituted a corporate group (Freeman 1968), defined as people who performed several activities together and who had a conscious feeling of attachment to the unit.

Because explicit criteria for this judgement are lacking, we must develop some standards. Recall that attributes involved in the analyses of activity groups not only are presumably nonfunctional, but also are idiosyncratic, in the sense that alternative attributes do not affect the usefulness of the object. Any of the basketry splices, for instance, are as functional as the others. It is doubtful whether these attributes might, as in the case of ceramic motifs or pictographs, serve as group labels or as conscious symbols of group identity. Since the observed clustering of these attributes is presumed by the model to represent the unconscious preference of a group of individuals who interact more with each other while performing the activity than with nonmembers, the nonutilitarian nature of the attributes seems a necessary assumption (Longacre 1971; Deetz 1968). This determination is itself a subtle and difficult task; the attributes investigated in the foregoing analyses apparently meet this criterion. One obvious way of attacking our results would be to demonstrate a functional value for these attributes, and then show that the functional value more successfully accounts for the observed distribution.

Given the unconscious nature of the attributes, the demonstration of corporate groups will be more credible if common attribute clusters

are developed from a wide range of artifact types, representing a wide and diverse range of activities. It would be better yet if these attribute clusters should correspond in location with phenomena (e.g. ceramic motifs or pictographs) that could be interpreted as group labels.

A necessary assumption for Antelope House is that the deposition of secondary refuse which produced the material we studied corresponds to the "territory" of the group in question, or that it varies with the presence of this group in a regular manner. Obviously, we will locate only territorial (localized) groups in this way.

This assumption can be rendered more plausible for the correspondence between the patterning of architectural attributes and the various categories of portable material. Architectural remains constitute the only significant amount of *de facto* refuse at the site.

In order to demonstrate the presence of localized corporate groups, therefore, we specify that nonfunctional attributes from several artifact types should cluster together. At Antelope House, we expect these clusters to localize in the separate room blocks. More clusterings tend to confirm the corporate group hypotheses.

Models of postmarital residence involving clusterings have specified that only artifacts associated with one sex or the other will cluster, depending on specific descent rules. In an ideal neolocal situation, the associated artifacts and their attributes will tend to randomize (Deetz 1968: 46).

Our interest in the social organization of Antelope House grew during superficial examination of the architecture of the site, particularly when the difference between the North and South Room Blocks was demonstrably not the result of differential preservation.

Social organization was approached eventually through separate studies of architecture, ceramics, basketry, sandals, textiles and *Zea mays*. Taking advantage of the wide range of materials preserved at the site, we explored some rare artifactual categories to test more rigorously and broadly for the presence of prehistoric social groups. Efforts were concentrated on Late Pueblo III because of the abundant material from this period.

Absolute proof for these groups is difficult to achieve, short of some pictorial or written record, but if inhabitants of different areas of the site built differently, painted their pottery differently, wove differently, cultivated different seed lots, etc., then an internal social division becomes a more and more likely explanation.

It is not necessary to assume that the differences observed in the archeological record were consciously achieved by the groups involved. It is likely that many were not, but arose simply from interaction with other members of the artisan group/activity group/population/etc. producing the item in question.

The question of social organization is first viewed from the perspective of the site's architecture, noting differences in room size, kiva details, multistory construction, pictograph occurrence, and wall finishing. These obvious differences provide the basis for the studies of portable material presented in this volume.

An assumption inherent in the studies of these portable artifacts is that the distribution of the artifacts reflects in some regular manner the area utilized by the group.

Hall demonstrates that the corn cobs from the site appear separable, on the basis of row number, into two major groups, with the Central Room Block different from the North Room Block, but more closely related to it than to the South Room Block.

Magers approaches social group organization with a hypothesis which, alone among the investigations reported here, does specify recruitment of group members—either room block endogamy or patrilocal postmarital residence. This approach was taken because of the very close parallels to modern Pueblo ethnography present at Antelope House—room blocks containing kivas in which weaving was done (inferentially, by the men of the group). Results indicate that either or both of the rules did not hold for the group.

Thornton, investigating the activity groups which produced utility ceramics at the site, located significant differences between room blocks. The pattern found normally contrasted the South Room Block with the North Room Block, either alone or grouped with the Central Room Block. In two of the attributes tested, each room block varied from the other two. In only one case was the Central Room Block contrasted with the North and South Room Blocks together.

Technological attributes of the basketry collection studied by Adovasio revealed spatial pat-

terning most readily interpretable as social group differences among the portion of the Antelope House population making baskets. In basketry attributes, the North Room Block is distinguished primarily on the basis of higher plaiting angle, the absence of Type XII plaiting and larger coil element diameters.

The aim of these exercises has been to test major artifact categories for variability that may describe prehistoric social groups. The bridging mechanism between the intangible of group membership and the tangible artifact attributes is the transmission of particular techniques, frequently idiosyncratic, from one member to another during the craft learning process. This project has examined many artifact types, but more could be profitably examined.

The analysis of different artifact categories supports the hypothesis that two equivalent social groups existed contemporaneously at Antelope House, one on each side of the Central Plaza; that is, the attributes selected for study demonstrated a nonrandom occurrence within the site. Seven artifact categories were examined for distribution of attributes; four categories sustain the hypothesis (architecture, utility ceramics, basketry and *Zea mays*); two deny it (textiles and sandals), and one is inconclusive (decorated ceramics).

On balance, it is reasonable to accept the hypothesis that distinct social groups were present at Antelope House. More often than not, our analysis confirmed the hypothesis. We do not feel that our research strategy has lead to definitive, clear-cut results. There is plenty of room for new ideas and better methods in resolving questions about social organization.

The artifacts which show no significant clusterings could be interpreted as evidence of a matrilocal residence pattern, since loom woven textiles possibly were produced by males, ceramics and basketry by females. Architectural features and seed corn would have been under control of the women of the hypothesized territorial, matrilocal group. In a matrilocal group in which males were weavers, textile attributes would be expected to occur in a random manner, which is the situation found at Antelope House. One would have to assume that sandals also were produced by males, an assumption which may well be incorrect. The attributes of the architecture and *Zea mays* categories would result from the attitudes and behaviors of the females who controlled crucial aspects of the artifact in question.

Other explanations also are possible. The randomization of male-produced artifacts can be explained by considering work group size and composition. Previously compared were the wider-ranging hunting practices of males and the gathering practices of females, the latter concentrating on plant groups near Antelope House. If hunting groups were recruited from the total male population of the site, we can readily postulate the opportunity to interact as a total unit in this and similar activities as an explanation for the random occurrence of attributes in male-produced artifacts.

We are reluctant, therefore, to accept kinship and postmarital residence rules as explanations for the observed stylistic variation.

This study, in effect, tends to confirm comments on social groups and their presence within sites that frequently are based on architectural evidence alone (Rohn 1971; Dean 1972), indicating that these corporate groups may manifest themselves through a variety of artifact types in addition to overall architecture: kiva architecture, crop types, basketry and utility cooking vessels. The concentration of rock art and kiva art in the vicinity of the South Room Block suggests their use in a conscious symbol system promoting group identity.

Two opinions characterize thought on the development of Pueblo social organization. Eggan (1950) advanced the matrilineal clan, which survives among the Western Pueblos, particularly the Hopi, as the original primary unit, while the Eastern Pueblos, with their emphasis on moiety organization and weak clan development, represent an adaptive response to the need for large scale irrigation works and to other environmental pressures. Robin Fox (1967, 1972), however, has suggested that the duality seen in the Eastern Pueblos is the principal organizing relationship in Pueblo society.

We suggest that the information from Antelope House supports both schools of thought. If the maximum population of 50 individuals were split into two groups, the size of each social unit would be adequate for a functional Pueblo clan. While as definitive a label as "clan" is unwarranted for the units identified at the site, our

data contradict neither such an assertion nor Eggan's hypothesis. It is clear that these social units, whatever they were, were paired within the site; in fact, we see evidence for this organization in numerous other sites throughout the canyon, so that the data confirm Fox's position.

In short, Antelope House represents a prototype community of social groups with unspecified recruitment techniques organized in contrasting dualities, the organization serving as predecessor to either the Hopi clan or the Rio Grande moiety.

We have analyzed data only for Late PIII times, but the development of the site indicates that the southern group settled Antelope House first and was joined by the northern group in Early PIII times. In Late PIII times, the latter groups shifted to the Central Plaza.

Many details in the archeological record suggest higher status of some sort for the southern group. These include smoother plaster on room walls, multistory architecture, kiva decoration, and concentration of turquoise and shell in the deposits in the South Room Block. One must remember when analyzing the distribution of portable artifacts at the site that more trash is available from the South Room Block than from the North Room Block.

Our analyses, then, seem to confirm the localization of two corporate groups, one in the South Room Block and one in the North Room Block. The site can be partitioned through the middle of the Central Plaza to separate the remains of the two groups. In situations where three groups, corresponding to the North, Central and South Room Blocks, can be differentiated, the central and north groups are closer together, a finding which conforms to the internal stratigraphy and development of the site.

These two groups built their rooms and kivas differently, made baskets in different ways and utilized different coiling techniques in their utility vessels. While their decorated pottery designs cannot be reliably separated and everyone seems to have worn the same type of sandals, overall differences outweigh similarities and appear to be of a more fundamental nature, particularly those related to architecture, room size, and variations between kivas.

As noted previously, pictographs are more prevalent in the South Room Block than elsewhere. While interpretations of rock art vary, frequent instances are cited of purposeful symbolization in the production of particular motifs (Colton 1960: 78; Ellis and Hammack 1968). Ellis and Hammack go so far as to use the term "glyph" to indicate the regular degree of symbolization inherent in some motifs. We are inclined to regard the pictographs at Antelope House as purposeful, rather than as random doodling. The presence of several symbols in the South Room Block, such as the swastika-like figures, suggest that one or several of these might be group identification symbols, since their distribution is restricted to the southern area of the site. The placement of virtually all of these symbols is relatively high on the walls of the rock shelter, a so-called billboard location. Many of these areas are difficult, if not hazardous, to climb to, further supporting our judgement that the production of rock art was purposeful.

Conclusions

The foregoing analysis and discussion establish relatively good evidence for the presence of two corporate groups at Antelope House during Pueblo III times. It is further suggested that a group of male-related activities indicates that the men of the pueblo interacted more as a group than did the women; female-related activities formed relatively isolated groups. This patterning could result either from postmarital residence rules or from practices which would bring males together in large groups, such as hunting or communal work projects of various sorts.

The prominence of dual social organization resembles the modern Eastern Pueblos more than the Hopi. Although most ethnographic analogies for the Canyon de Chelly region have used the Hopi as a model, our findings indicate that the Hopi cannot be used exclusively as a model for the de Chelly Anasazi. Antelope House stands at the social organization crossroads, intermediate between the Eastern and Western Pueblos, just as it occupies an intermediate position in ceramic design.

The description of two equivalent social groups at the site should come as no surprise; dual social units are thoroughly documented for the Tewa by Ortiz (1967, 1972), who interprets them as evidence of dual organization of subsistence activities and who perceives a pervasive dualistic classificatory scheme (Ortiz 1967:

191–192). The Tewa moieties are nonexogamous and nonlocalized (Ortiz 1965).

The dualistic principal can be discerned in all pueblo groups, although to a lesser degree among the Hopi (Eggan 1950; Parsons 1939; Titiev 1944), whose clans are nonlocalized (Thompson 1944; Mindeleff 1897). Dualistic organization is more prominent among eastern groups, reaching its extreme in the Tewa moieties, in which membership is localized on the basis of which section of the village is inhabited.

Dual site divisions occur frequently in descriptions of the Anasazi pueblos. The ground plans of Pueblo Bonito (Judd 1954), Kin Kletso (Vivian 1964) and Kin Bineola (Voll 1967; Morris 1968) all suggest a dual architectural division, from which a dual social organization may be inferred. The same statement applies to Mug House in Mesa Verde, where corresponding differences within kiva architecture are noted (Rohn 1971: 40). We believe that Fox is correct in regarding dualism as an old and fundamental feature of Pueblo social organization. The dualistically opposed corporated groups may well be the matrilocal clans of Eggan.

Chapter 29

Conclusions

We have endeavored to present in the preceding pages a detailed account of the archeological record at Antelope House, along with inferences about environment, subsistence practices, diet and its changes through time, social organization, and demography.

The earliest known occupation of the site occurred about AD 700 with the establishment of a Basketmaker III village of unknown extent. This was succeeded by an extensive Pueblo I village, constructed in the first half of the 9th century. Although the layout and composition of this complex are not well known, it covered an area slightly larger than that of the later pueblo.

Following a possible hiatus, a Pueblo II unit was built in the south end of the site no later than AD 1050. The establishing group, probably including no more than 15 people initially, built additions to the north during a favorable climatic interval. A second and equivalent unit was built during Early PIII times (1100–1140) in the area north of what was to become the Central Plaza. It is not known whether this group budded off from the original group or moved into the site from a nearby location, such as Battle Cove.

There is considerable evidence for less rainfall in the canyon during the following Middle PIII period. The archeological record for this time shows changes most sensibly interpreted as responses to drought: aggregation of people at the site and development of high-rise architecture, fewer cultural items discarded in the trash and less frequent occurrences of species associated with very wet conditions. The end of the period is defined by the construction of the Central Plaza, the open area between the two house blocks, which suggests a sort of social reorganization at the site. A short while later, the North Room Block was partially abandoned and new rooms, including a kiva, were built within the Central Plaza; small storage units were built around this unit. The smaller rooms suggest that smaller units or groups were controlling food storage, in contrast to earlier periods, when storage rooms were much larger and presumably served a larger group.

Middle Pueblo III Stress

The nature of the stress in Middle Pueblo III times seems to have been relatively straightforward: decreased rainfall at times reached levels characterized as severe. Other environmental variables were not involved or functioned as dependent variables related to precipitation. This site is situated in a well watered canyon, which would offset drought effects to a large extent, so that the problems presented by this situation could have been resolved by more intensive labor and by more intensive utilization of resources; wells could be dug in the canyon bottom, plants could be watered by hand, and irrigation ditches

could have been dug. The difficulties which followed this period, however, required more complicated solutions, which, in many cases, were quite beyond the technological capabilities of the group.

If Middle PIII times were subject to drought, the population at Antelope House seems to have adjusted well. Population increased, several additions to the structure were made and, in the ethnocentric terms of the archeologist, the site could be seen as "reaching a climax" in material culture.

There are, however, changes in the character of the rubbish deposited at this time; less was thrown away during this period than in Early PIII or Late PIII. This decrease in quantity is so pervasive that we considered whether it might be the result of some undetected change in our excavation or analytical procedures. Because we were unable to locate such bias, we tend to accept the data and their implications: relatively little was thrown away.

One of the proposed characteristics of systems under stress is that performance initially exceeds ordinary levels and then declines as stress continues (Miller 1965: 401; Martin and Plog 1972: 208). Antelope House in Middle PIII times can be seen as existing in an environment of "optimum stress." Output, as measured by rooms built, the beginning of multistory additions, an attention to the finishing and decorating of kivas, and manufacture of elaborate and finely finished artifacts, reaches a high point at this time.

Subsistence and Technology

Key items of technology and subsistence at Antelope House are relatively few. The most significant cultivated or domesticated foods are corn, squash, cotton and turkeys. Beans and dogs are excluded from this group, since they were not consumed regularly.

Corn, the mainstay of subsistence, was regularly found in trash, feces, and pollen deposits. Although sometimes eaten green on the cob, it was characterically ground and consumed in a mush, primarily with other foods. Inedible portions of the corn plant, frequently found in the trash, often were incorporated in such artifacts as loom anchors and mats.

Squash was an important food, but the plant parts are rarely found in deposits. A few gourds may have been used as containers and occasional gourd fragments show use as scrapers.

Cotton and turkeys can be considered together, since they both provided essential food and fiber. The production of both cotton textiles and turkey feather blankets increased toward the end of the Late PIII occupation. Cotton seeds and turkey meat contributed important nutrients to a corn-based diet; our analysis indicates they were the greatest sources of protein and fats.

The large artiodactyls were the most significant game animals, providing most of the meat obtained through hunting. Of pronghorn, bighorn and mule deer, mule deer was far and away the most significant until Early PIII times, when it was rivaled by antelope. In addition to meat, these animals were the source of most of the worked bone at the site. Although much of the hide from Antelope House remains unanalyzed, our impression is that the majority is deer hide. Deer would have been hunted primarily on the plateau above the canyon, where pinyon could also have been gathered. Although pinyon nuts were recovered from feces, they do not appear to have contributed as much to the diet at Antelope House as did the mule deer.

Tools for manipulating and processing these materials were fabricated from local materials. Hammerstones and pounding implements were made from the abundant petrified wood of the Chinle Formation and from the sandstone concretions of the de Chelly. Cutting implements were made from the chert and chalcedony, also found in the Chinle Formation, and grinding implements were made from the de Chelly sandstone, which also furnished slabs and blocks for masonry construction. Few manos were fashioned of basalt, although a supply of basalt was available at Black Rock. Hematite is the only reasonably common lithic material which was not readily at hand.

The gathered plant used in the widest variety of applications was the yucca. The fruit was an occasional food and the leaves provided an immense amount of fiber for the manufacture of cordage, which in turn was used in weaving turkey feather blankets, other nonloom textiles, and sandals. An exceptionally wide range of artifacts was produced entirely from yucca or incorporating yucca to some extent.

Riparian plants perhaps were the most heav-

ily used group of plants in the area. Cottonwood, one of the more important of these, was used routinely for roof beams, in other structural members, and in numerous artifacts of both wood and bark. The willows were used in many similar applications and are prominent in coiled basketry. *Scirpus* was the typical material for production of matting and other artifacts. *Phragmites* reed was incorporated into arrowshafts, roofing material, and numerous other articles.

Juniper was employed commonly in artifacts and for firewood; its shaggy bark frequently was used for padding.

Another group of gathered foods, consisting of cactus (*Opuntia spp.) beeweed (Cleome*), Chenoams (*Chenopodium* spp. and others), and rice grass (*Sporobolus*), was important at Antelope House. All of these occur in dense populations on the canyon floor today. The various *Opuntias* were particularly common in the diet, as was beeweed. If beeweed were consumed as a potherb, as suspected, its caloric contribution would not have been particularly significant. Ricegrass was employed as a closing material in some roofs and for other purposes.

Synthesis

Storage, use and manufacture of the above articles appear to be attributable to the family or lineage, there being no larger specialized communal storage facilities. A possible exception to this statement is the specialized grinding area in Room 30, a specialization which did not endure. This observation is of some importance, since it is a necessary condition for the rationale we have followed in analyzing social organization; that is, relatively small units, essentially of family size, produced and consumed artifacts and associated residues in a relatively independent manner, embodying microtraditions and idiosyncratic attributes that separate their products from those of similar units.

In general, local plant resources were the most commonly used. The farther away from Antelope House a plant can be demonstrated to grow, the less likely it is to be found in deposits or incorporated in artifacts. The foregoing inventory, therefore, is specific to Antelope House and we predict that it will not be found to be representative of other sites within Canyons del Muerto and de Chelly, and that inhabitants of sites elsewhere in the canyons, with access to different plant communities and exposed to different microenvironments, might use equivalent local species for raw materials and foodstuffs. The specific uses and proportions of use of plants or animals at Antelope House is even less likely to be representative of the Anasazi area in general. While the strategy employed by each Anasazi group may have been the same, the exact mix of utilized plants and other dietary elements would vary with local resources, with their abundance and distribution, and with cultural attitudes and preferences.

Thus, while pinyon is common in the diet at Antelope House, it apparently was not consumed at Mug House (Rohn 1971: 261). *Descurania* sp. was a staple in the BMIII Durango sites. but it does not occur in Canyon de Chelly (Morris and Burgh 1956). Bighorn sheep are more prominent in the trash of PII sites at Mesa Verde (Hayes 1975) than in comparable levels at Antelope House.

The presence of raw cotton at Antelope House, considering its absence at Mesa Verde and Chaco Canyon (Pueblo Bonito), must be due to choice on the part of the inhabitants, who may have traded cotton cloth after consuming the plant's seeds. Cotton would have replaced beans to some extent as a source of protein and fats. Direct ethnographic analogy is hazardous under these conditions in dealing with specific plant uses. The data behind the interpretation of *Cleome* as a "starvation" food at Long House (Martin 1963), for example, appear to represent normal consumption at Antelope House.

Perhaps it is rash to claim that dietary findings at Antelope House are even moderately representative of prehistoric Anasazi diets, but there certainly are no data to preclude such a statement.

What is intriguing about the Antelope House diet is the continued prominence of gathered and hunted foods. While the universal presence of corn may indicate that dependence on agriculture increased through time, becoming most important by the Pueblo III period, gathered foods retained their importance to the extent that failure of these foods to occur in anticipated quantities would strain the subsistence system and would require considerable readjustment. The hypothesized floods and droughts during Middle PIII and Late PIII would have affected cactus, beeweed and pinyon throughout the area and

would have imperiled the subsistence system, regardless of what was happening to the cornfields. The rather surprising lack of drought effects in the corn recovered from Antelope House may be explained by the necessity to improve the corn yield because crucial wild foods were no longer available.

Dependence on agriculture, therefore, does not necessarily mean independence from gathered wild foods; this finding is compatible with Boserup's (1965) hypothesis of increasing productivity generated by population increase. In another sense, the hunting-gathering lifestyle of the Desert (Jennings 1952) or Picosa (Irwin-Williams 1967) cultures, is readily evident in the subsistence practiced at Antelope House.

Although our screening technique may have increased the recovery of inconspicuous textiles by as much as 50 percent (Magers 1975), many more textiles came from Antelope House than is usual. Excavations recovered immense quantities of basketry, matting, sandals, feather robes and cotton cloth, contrasting sharply with other sites with similar preservation. We conclude, therefore, that the production of woven goods was of uncommon importance and that the de Chelly area may be seen as a center for the production of these goods. Although the people of the canyon made no ceramics distinctive enough to be granted a type label and description by archeologists, leading to the area's characterization as a cultural backwater (Steen 1966), it now appears that their misfortune was to produce goods which do not readily survive.

The emphasis on textile production extends to diet, where cotton seed is more common than beans. One wonders to what extent this was a deliberate, conscious decision to plant a crop yielding both food and fiber. As McKusick (Chapter 12) points out, turkeys had long been kept in the area, with the dual objective of producing food and feathers, a strategy parallel to that employed with cotton. Turkey management in de Chelly can be contrasted sharply with that in other areas, particularly Mesa Verde, where turkeys were kept for food, were penned indoors, and suffered disease more frequently. These differences seem at least as significant as ceramic types in defining major cultural areas.

The increase in textile production in Late PIII suggests the strengthening of regional ties through increasing trade. This finding is consistent with the considerable research demonstrating increasingly effective trade and communication over wider and wider regions (DiPeso 1975; Martin and Plog 1972). The implication for abandonment of the canyon is simply that wide knowledge and established ties would have favored the decision to migrate; we should consider positive factors as important elements in this decision, then, as well as such negative factors as drought.

The Crucial Years: Middle and Late Pueblo III

Our environmental analysis indicates that the Middle and Late PIII periods were considerably more stressful than were the preceding PII and Early PIII periods. The most notable demographic event is the concentration of population within the canyon during Middle PIII times. While the drought experienced at this time seems to explain the population shift, there seems to be no radical change in the character of the corporate groups detectable at Antelope House. They become larger, but the traditional spatial arrangement of room block and kiva remains. The largest increment of growth at Antelope House occurred from 1140 to 1200. Much of the building after that date apparently was devoted to remodeling of the site's usable space.

It is almost certain that interlocking mechanisms developed in response to problems engendered by this massing of population, but we cannot yet specify their nature. The establishment of the formalized Central Plaza in AD 1200 may be the architectural embodiment of these new institutions.

Growth at Antelope House has been accounted for in plausible fashion by the contemporary abandonment of plateau sites. If this is an accurate reconstruction, a wider variation in attributes and new traits might be expected to appear in Middle PIII, allowing for the effects of sample size. This, in fact, seems to be the case. Middle PIII sandals exhibit more variation than is found earlier or later (see Chapter 18). Variability in room size also increases in Middle PIII and new masonry styles appear; multistory architecture is introduced, probably in response to the larger population.

We have portrayed the environment from 1140 through the abandonment of Antelope House around 1270 as grim, certainly below optimum.

Table 218. Regulatory mechanisms, Pueblo III.

Cultural	*Natural*
Population:	
(1) Migration	(1) Decrease fertility of known population
(2) Infanticide	Increase mortality of known population
(3) Spacing of births	(3) "Pray for rain"
(4) Warfare	
Carrying Capacity:	
(1) Migration	
(2) Utilize new food sources	
(3) Intensify food cultivation (irrigation or other land modification, depending on technology)	
(4) Improve storage	

This condition resulted from drought, erosion and general cooling. It appears that the groups living at Antelope House adjusted and readjusted to stress until conditions deteriorated to the point at which depopulation of the site resulted.

Ford (1972: 15) has discussed the regulation of stress in Pueblo societies, defining stress as a change (for the worse) in the ratio of people to effective carrying capacity of the local environment and suggesting migration and warfare as effective regulatory mechanisms. These mechanisms, however, seem most appropriate for large scale stress. Several interim strategies for intermediate and low level stress seem plausible.

Ford's neat formulation of the essential problem as the ratio of people to carrying capacity suggests that we can categorize regulatory strategies as (1) attempts to reduce or stabilize population, or (2) to increase carrying capacity. These, in turn, can be categorized as cultural or natural in character (Table 218).

The natural/carrying capacity intersection is the empty set, except for the perceived effectiveness of appeals to the supernaturals who regulate critical natural processes. Many archeological phenomena fall into the cultural/carrying capacity set, particularly those strategies which would leave material evidence.

The carrying capacity of a region, measured by both wild and cultivated products, is translated into effective human nutrition and sustenance by means of the food storage and preparation systems developed by a culture. As the carrying capacity declines, an attempt to improve the efficiency of and to decrease losses within this system is one logical response. We can discuss the storage system at Antelope House in these terms.

Well defined, "unambiguous" store rooms are rare in the PII and PIII rooms at the site, suggesting a generalized use of rooms for food storage and other activities. Food preparation and, by implication, some short term storage was centered around embedded pots, both in rooms and outside, and communal grinding rooms, which apparently were used in common by most of the inhabitants of the site.

The Late PIII pattern, on the other hand, features numerous small rooms of fairly unambiguous storage nature; these must have been intended for use by a smaller group than were rooms constructed during Early PIII. Embedded pots are no longer found, nor are communal grinding rooms.

One way to view these changes is in terms of a more efficient, more particularistic mode of storage. Pots embedded with their mouths flush with the ground surface, particularly when capped with sandstone lids, are more easily entered by small predators than are more mobile, upright pots; mobile pots can be placed in secure locations. We might anticipate that clay jar lids would be more common in later periods, in order to assure effective sealing. Only seven such jar lids were recovered, but six of them occur in Late PIII proveniences; the sample is not adequate, however, for statistical manipulation.

The lack of formalized communal grinding rooms also suggests more transitory, smaller scale efforts in food processing, with each group keeping tighter control over its food supply.

While exchange and reciprocity of foodstuffs may have functioned, as Ford suggests, to ameliorate the random effects of weather on crops and gathered goods, these archeological findings suggest that stewardship over the food supply took on heightened importance, a common response to a decrease in the carrying capacity. It may portend lack of cooperation and changes in the social system, an effect recorded for the Hopi under famine conditions, during which premeditated and skillful theft of food is recorded (Beaglehole 1937).

Efforts to increase the food supply constitute another possible strategy, one which should be detectable archeologically (bearing in mind the

much larger sample of Late PIII feces upon which these data are based). On balance, we accept the premise that storage and preparation of foodstuffs were modified toward greater efficiency during Late PIII times and that a wider variety of foods was eaten.

It seems that these strategies became ineffective by 1270 and that abandonment of the site ensued, as discussed in the following section. With increasing stress, we may postulate ever more negative biological effects on fertility and on infant mortality. Although our population analysis for Antelope House shows population holding at essentially the same levels in Middle PIII and Late PIII times, our temporal controls are not fine enough to project a valid picture of population change for the last 20 years or so of the site's occupation; precipitous population decline may well be concealed in our data. This speculation is advanced simply to note that only a fraction of the population may have survived to emigrate. While this group may have moved some distance, either they or remaining groups in the canyon cleaned the site of usable artifacts and roof beams.

Abandonment of Antelope House

Erosion of the fields surrounding Antelope House, and probably of the site itself, precipitated its abandonment in about 1270, before general abandonment of the area. This hypothesis can be tested by study and dating of the sediments in the vicinity of the site.

The hypothesis is suggested by the eroded condition of Antelope House in the 1890's and by the observation that no Navajo period structures or strata were affected by this erosion. Partial corroboration is provided by the bare, clean nature of the late floors in the site and by the absence of roofs and roof beams. The recycling of portable artifacts and beams by people occupying other sites in the canyon at that time would be expected.

If the canyon were cutting an arroyo toward its head, the population would have shifted upstream. Presently available data, although sketchy, tend to support this idea; only one very late PIII site, CDM 11, is known downstream from Antelope House. This site is situated high in the cliff in an "erosion-proof" rock shelter overlooking a deep rincon, which would contain some arable land even in the worst of erosion conditions. Other known later or potentially later sites, including CDM 174, (Mummy Cave) CDM 9 (Standing Rock) and BLR 1, are found upstream.

Although this explanation of the abandonment of Antelope House is highly particularistic, it offers an insight into the more crucial question of the steep population decline in the entire drainage during the last quarter of the 13th century.

The population shift into the upper portion of the canyon during the 1260's and 1270's would have rendered the new fields particularly vulnerable to a shorter growing season, brought on by the cooling trend which began at this time (LaMarche 1970; Longacre 1970). The population shift also would strain existing resources, including both cultivated crops and gathered foods. These resources would have suffered drastically at the beginning of the 1276 drought. Particularly hard hit would be such plants as the yuccas, whose reproductive capacity would be diminished under drought conditions. Stream community species (cottonwood and willow) would likewise suffer from the three-way strain of increased use, erosion, and sudden drought.

Thus the following trends were evident in the 13th century in the cultural system of which Antelope House was a part:

1. Population increase on an absolute basis, compared with earlier periods; because of dry conditions during Middle PIII times and the succeeding erosive interval, increasing restriction of the utilized environment.

2. Concentration of the utilized environment toward the upper portion of the canyon, an area where temperature fluctuations would assume more importance and where less acreage would be available for farming.

3. Onset of the 1276 drought and cool conditions, which rendered agriculture untenable and which triggered a sharp population decline through a decline in the reproductive capability of the population and migration to more suitable areas, such as the Hopi Mesas.

Summary

A large population stressed an environment already affected by alternating and increasingly severe episodes of drought and flooding. The useful range of the environment was lowered through time, since the final drought found the

population recycling on an unstable base. The large population and the sequence of environmental changes, rather than the magnitude of these events, are the crucial factors in understanding the population decline.

Project Assessment

How well did the Antelope House project achieve its original objectives? What work remains to be done in the canyon? Was the time and money worth the results achieved?

The Antelope House project has presented a fairly detailed view of a PIII pueblo site in Canyon de Chelly; while new insights have been gained, much of the work is descriptive and many intriguing and vital questions remain for further research.

Certainly our examination of the vegetal material from the site yields a comparatively detailed picture of plant materials available for human use in Canyon de Chelly during Pueblo III times. It is evident that the plant communities of today existed there in the past. The prominence of grasses in the archeological remains suggest that modern grazing has had the greatest impact on the modern plant communities.

One of the most important and versatile plants is the yucca. After recovering miles of yucca cordage plus hundreds of artifacts from one site, and considering the numerous contemporaneous sites, one wonders about the impact of all this use on the native population. Other species, such as the cottonwood and willow, may also have been seriously impacted.

Further work on this problem will require more comprehensive botanical work than that associated with the Antelope House Project, with major efforts devoted to off-site analyses and activities. Traditional site excavation will play a relatively minor role in solving these basically ecological questions. Simply excavating another pueblo will not solve anything.

The most unremarkable conclusion of this entire project may be that maize was the major food in the average diet. However, the variety of other foods is impressive. Despite the size and expense of the fecal study reported here, which is the largest and most comprehensive report of which we are aware, its sample size and statistical validity are open to question. Analysis of human feces has vast potential for increasing our knowledge of human diet and health in prehistoric times. With growing concern over chemical additives and highly processed foods, such studies should be important for living people today. Our study here can easily be improved upon with greater understanding of the effects of human digestion on ingested foods and better statistical techniques.

We have been unable to assess the relationship between humans and turkeys at Antelope House in terms of their mutual diets, as originally intended. It is a significant problem worthy of research, but we had to stop somewhere.

Our conclusions about site abandonment and social organization have been presented at length. They do not represent the final words on these subjects. What we have said represents our best reasoning based on the evidence and models currently available. We can only hope that better is available soon.

It is evident that the research potential of the great mass of twigs, feces, rags, and cobs garnered as a result of the excavations at Antelope House has not been exhausted. It is reasonable that this material be preserved for use in future studies.

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